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ONE METHOD OF SECURING MUNICIPAL ECONOMY.

Our foreign exchanges report that at one of the meetings of the South African Lighting Association, to account for the shrinkage in the consumption of gas, it was explained that the government of Cape Colony has adopted a standard time which moved forward the day one hour. Now, the people of South Africa regulated their daily affairs by the clock before this change, and they still do so. They rise one hour earlier, and go to bed accordingly. This shifting forward of the day in effect extends twilight into the night. Street lamps are lit an hour later—according to the clock—and as they are extinguished at the regular time, an hour of lighting is saved. It does not appear that the new life is less enjoyed than the old, as doubtless the chickens, cats and other domestic animals have also adopted the new day. This is surely an exceedingly simple and effective method of reducing one item of municipal expense, and we recommend it to those towns which, owning municipal plants, each year have the hard problem of making the income meet the expenses.

LOW-PRESSURE STEAM TURBINES.

Discussions of the problems involved in the construction and operation of steam turbines appeal particularly to engineers, since not only are many of the members of the profession engaged in installing these prime movers in new and in remodeled stations, but many—we may say all—are studying the subject with more or less care. For this reason a paper entitled "Different Applications of Steam Turbines," presented by Professor A. Rateau, of Paris, at the recent joint meeting of the American Society of Mechanical Engineers and the British Institution of Mechanical Engineers, at Chicago, Ill., is particularly acceptable, since the author has had many years experience in the construction and testing of these machines.

Use of Low Pressure.

This paper gives a good deal of information respecting that type of turbine which is designated by the author's name. The last section of the paper is devoted to a special application of the turbine, which is most interesting. Engineers of electric power stations, recognizing fully the economies to be effected by securing uniform loads on the station, often go to considerable expense to obtain a better load-factor. But the load on an electric station is remarkably uniform in comparison with the conditions obtaining in certain other installations, such as rolling mills and in mines. The application of a condensing plant to such engines is particularly difficult, and they usually exhaust freely into the air. Professor Rateau has given special attention to the problem of employing this waste steam, and he has obtained satisfactory results by means of a low-pressure steam turbine, combined with his regenerative accumulator. These turbines have been made use of to drive dynamos, pumps or fans, and they develop one electric-horse-power for about thirty-one pounds of steam per hour, working between fifteen pounds admission pressure and a vacuum of twenty-seven inches of mercury. From a moderate-sized mine, consuming 13,000 pounds of steam per hour, it is possible to save under these conditions about 350 electric-horse-power. In a steel mill where reversible steam rolls are employed, consuming about 45,000 pounds of steam per hour, by means of accumulators and turbines an extra output of over 1,100 electric-horse-power may be developed. These striking results are due to the ability to realize a large ratio of expansion in the steam turbine, even when furnished with low-pressure steam, if a good vacuum is maintained. This is impracticable with a reciprocating engine, because the latter for such use becomes bulky and cumbersome, and its internal losses increase more rapidly than the increase in power due to increased expansion. This difficulty is not met in a turbine, as the increased expansion is effected easily by increasing the number of stages during which it takes place, or by

increasing the speed of the turbine wheel. But to utilize this waste of steam successfully we must be able to drive our secondary engine continuously, and since it is the intermittent character of the work done by the prime mover that makes it impracticable to apply a condenser directly, there must be between the main engine and the secondary engine some form of accumulator or steam storage apparatus. It is on the satisfactory design of such an accumulator that the success of the low-pressure turbine depends.

The Regenerative Accumulator.

The earlier type of accumulator designed by Professor Rateau consisted of a steel cylinder containing a large number of cast-iron trays, piled one upon the other, and each holding hot water. The exhaust from the main engine was discharged into this accumulator, and the supply for the turbine drawn from the same point. When the supply of steam to the accumulator was greater than that drawn from it, the steam pressure necessarily increased. This caused the entering steam to be condensed, the water formed being added to that already contained in the trays. When the demand on the accumulator was greater than the supply, the steam pressure decreased and the water in the trays immediately began to evaporate, the heat necessary being drawn from the cast-iron trays. The accumulator thus responded automatically to the variations in supply and demand. The second solution of the problem gave rise to the accumulator containing water only, in which a rapid circulation was produced by the injection of steam into the body of the liquid itself. To enable the turbine to operate when the main engine is not running at all, an automatic expander was added to the accumulator. This apparatus comes into use when the pressure falls below a certain predetermined point, and it admits to the turbine live steam, which is passed from the boilers through reducing valves. If the demand for live steam extends over considerable periods, it may be advisable to add to the low-pressure turbine a high-pressure turbine, which would receive live steam at boiler pressure during the time that the prime mover was not working.

These results are not merely of theoretical interest, but they have been obtained in practical work. The field of application for this system would seem to be fairly large. In some cases it may enable the present system of steam driving to be maintained, when otherwise it would appear advisable to replace it by an electric motor drawing power from a large central station. It is an interesting case of the creation of a new field of application by the invention of a new, or, we would rather say, by the development to a practical stage of an old prime mover.

ELEMENTS AND COMPOUNDS.

The title of the Faraday lecture delivered in April last before the Chemical Society, of London, by Professor W. Ostwald, was "Elements and Compounds." This seemed to the lecturer to be particularly fitting, since not only was Faraday interested in the notion of transmutation of the elements, but Professor Ostwald, who considers himself in a special sense to be a pupil of Faraday, has also given this subject much attention. However, the views which he presents here would not have been made public at this time had not the hypothesis of the disintegration of radium, suggested recently, made the present time seem appropriate. In his lecture Ostwald gave due credit to Herr Franz Wald, the chief chemist of the Kladno Iron Works, in Bohemia, who was the first to give proof that it is possible to deduce all the stoichiometrical laws from the principles of chemical dynamics.

To deduce the laws of definite and multiple proportion, heretofore it has been necessary to introduce the atomic hypothesis. This, according to Ostwald, is unnecessary. To prove it he starts from the concept of equilibrium—that is, a state independent of time. For the existence of such a state it is necessary that temperature and pressure shall remain constant. It is a general experimental law that the possibility of such a state is dependent on the homogeneity of the system, and the lecturer limited his considerations to such a system. It is possible, however, to have a body in two different states at the same time, such as water and water vapor, but this is not a contradiction of the previous statement of homogeneity. To meet this condition, the concept created by Willard Gibbs, known as "phase," is introduced. The water is itself homogeneous, and the vapor also since equilibrium can not exist unless this be the condition, but there is the possibility that a finite number of different homogeneous bodies can exist together without one disturbing another, if the temperature and pressure be the same everywhere. The specific volume and the specific entropy may, however, change from one body to another. A phase is every part of the system where these specific properties exhibit the same value.

Every system consisting only of one phase has two degrees of freedom. The assumption is here made that the sole forms of energy involved in the system are heat and volume energy. This law is valid for any pure chemical element, or for any mixture, since it is impossible to change it in more than two ways—namely, temperature and pressure. The existence of such a body in the shape of only one phase is generally limited in at least one direction. If the pressure be lowered at constant temperature, a liquid or solid will change into a gas. If the temperature be lowered at constant pressure, the gas will change into a liquid, and a liquid into a solid. If the limit of existence of a phase is passed, a new phase is formed, the spheres of existence of the different phases limiting one another. By granting the coexistence of two phases, we lose one degree of freedom, and, at the same time, a new variation arises in the ratio between the masses of the two phases. The most general case of a change from one phase to another is one during which the properties of both are changing continually. By evaporating sea-water at constant temperature, the density of the residue grows higher, while the pressure and therefore the density of the vapor decrease. Evaporation of distilled water does not show any such change in the properties of the residue and of the vapor. Bodies of the first class are called solutions; of the second, hylotropic bodies. Hylotropic bodies are not necessarily chemical individuals, but the possi-

bility of being changed from one phase into another, without variation of the properties of the residue and of the new phase, is a most characteristic property of a substance or chemical individual. Representing these changes by rectangular coordinates, taking as abscissa the part of the first phase converted into the second, and as ordinates pressure or temperature, the characteristic of a hylotropic body is a horizontal straight line. A solution gives a continuous line, but it is not horizontal, and generally not straight.

The general process of change in a solution while it is being vaporized is, the residue is always less volatile than the original solution, and the distillate more volatile. If the reverse were true, the process of vaporization at constant temperature would be explosive. With a solution there is always a stable equilibrium. With hylotropic bodies there is an indifferent equilibrium, because the state is independent of the progress of the transmutation. If the separation of a solution into a less and more volatile part by repeated distillation is continued, two cases may happen: the residue may become less and less, and the distillate more and more, volatile, and there is no end to the progress. This case experimental evidence of a most general character excludes. The conclusion is therefore reached that there is a limit of volatility on both sides, and that finally the solution is separated into the least and the most volatile part, and that both parts will not change further by repeated distillation. While but two parts have been considered, it is evident that the same law will apply to solutions containing more bodies. We thus deduce the general law that it is possible in every case to separate solutions into a finite number of hylotropic bodies.

The boiling points of all solutions formed by two hylotropic components yield three types of curve. The curve may rise continually, or it may have a maximum boiling point or a minimum at some point. The solution corresponding to that spot must behave as a hylotropic body, though it is a mixture. This is not a contradiction of what has just been said, as the following considerations will show. Trace a series of boiling-point curves for different pressures and the distinguishing points will lie either on the same vertical or they will not. In the first instance, where the points lie all on the same vertical, the hylotropic body would be a chemical individual, though not necessarily an element. This gives the exact definition, that a substance or chemical individual is a body which can form hylotropic phases within a finite range of temperature and pressure. Such substances can often be produced from other substances by putting them together; but, from the definition, the inference may be drawn that there exists a definite ratio between the components, independent of temperature and pressure between certain limits. This is essentially the law of definite proportions.

If the limits of temperature and pressure, where the body behaves as a hylotropic one, be exceeded, it assumes the properties of a solution, and its distinguishing point begins to shift. It thus becomes possible to separate the body into its components—in other words, to dissociate it. Most substances behave in this way, but there are substances which have never been transformed into solutions, or the sphere of existence of which covers all accessible states of temperature and pressure. Such substances are called elements. In other words, elements are substances which never form other than hylotropic phases. Every solution can be separated into a finite number of hylotropic components, and since a solution is the most general case, we may conclude that every body is finally transferable into such components. These, again, can be transferred generally into a state where they behave like solutions, and can be separated further. Finally, the components remain hylotropic through the whole available ranges of temperature and pressure—that is to say, they are elements.

To deduce the law of combining weights, Professor Ostwald proceeds as follows: suppose three elements, A, B and C are given, which may form binary combinations AB, BC and AC, and besides these, a ternary combination, ABC; there shall be but one combination of every kind. To form the combination AB, a certain invariable ratio between the weights of A and B must be taken, according to the already proved law of constant proportions. To combine AB with C, there must also be a certain ratio between AB and C. Adopting one of the elements as unity, certain numbers can be assigned to the others, describing their combining weights relatively to this one. If the compound ACB is to be formed from AC and B, since the resulting compound can not be different from ABC, it must show the same ratio between the relative weights of its elements. Therefore the ratio of the weights of A and C, in forming the combination AC, can not be other than that expressed by the relative combining weights already found in the first way. This is nothing less than the general stoichiometrical law of combining weights, for these considerations can be extended without difficulty to any number of elements. The law of multiple proportions follows from the law of combining weights, for no compounds can be formed except according to their combining weights. Then, if there are two different compounds between A and B, the one containing more of B can be formed directly from A and B, or indirectly by combining, first, A and B to form the lower compound, and then combining these with more of B. Thus, any multiple of the elements may occur in combination, but no other ratio.

Having thus deduced the general stoichiometrical laws, Professor Ostwald added a few words explaining his idea of the nature of atoms. In this he is on the same ground as Faraday, although the latter clung to the atomic hypothesis. Faraday held to the idea that we know matter only by its forces, and that the atoms are only mathematical points, whence the forces emerge or where the directions of the several forces intersect. Expressed in the language of modern science, this may be put as follows: what we call matter is only a complex of energies which we find together in the same place. We are still perfectly free if we like to suppose either that the energy fills the space homogeneously or in a periodic or grained way. The latter assumption would be a substitute for the atomic hypothesis. The decision between these possibilities is a purely experimental question, but

there are a great number of facts—and among these the chemical facts—which can be completely described by homogeneous or non-periodic distribution of energy in space. If there are any facts which can not be described without the periodic assumption, the lecturer did not know of them.

This, in brief, is the argument of Ostwald, and while he may appear at times to be arguing in a circle, a closer study seems to show that this is not the case. These ideas have received Ostwald's attention for a number of years past, and although they are addressed particularly to the chemists, they can not fail to be of great interest to the physicists, who are themselves trying on, as it were, a new theory of matter. The point to be noted particularly in the suggestions is that they rest entirely upon the laws of energy. There is no attempt to show that the atom may be broken up into smaller bodies. In fact, the words "ion" and "electron" are not even mentioned.

A Three-Phase Phenomenon.

At a recent meeting of the Dublin local section of the British Institution of Electrical Engineers, an explanation was suggested by Mr. W. Tatlow for the fact that comparatively large currents, which would be attributed to faulty insulation, have been observed in wire which connects to the ground the star connection of three-phase alternators working at the Pidgeon House Fort station, in Dublin—an abstract of this paper is given in the *Electrician* (London), May 27. By applying Fourier's theorem, it was shown that the harmonic pressures of three (or multiples of three) times the main frequency are the same in magnitude and direction in all three phases at any moment, whereas the fundamental and remaining harmonics differ by 120 degrees in phase in each of the three phases. It follows from this that, in a mesh-connected winding, harmonic pressures of three times (or some product of three times) the fundamental frequency will, if present, add together and drive idle currents around the mesh. On the other hand, the fundamental and remaining harmonics form balanced sets, the sum of the three pressures due to any of them taken around the mesh being zero at any moment. In the case of the star winding, the harmonics of the third order will tend to drive current into or out of the star point equally in all three windings at any moment, and therefore they will be balanced. Hence harmonics of the third order are eliminated by the star connection, so far as pressures between any pair of the three wires coming from the machine are concerned. They appear, however, in the pressure wave taken between any of the three leads and the neutral point if they happen to be set up in the windings. Therefore, the waves of pressure between lead and lead, and between any lead and the neutral point, will differ in form. If the star point of the three-phase generator is connected to the earth, and the leads bringing current from the machine are in the form of a three-core lead-sheathed cable, the harmonics of the third order will give rise to a capacity current going to earth from the neutral point, and charging the cable sheath. It was shown by Mr. Tatlow that the mean potential with three cores is not zero, but a fluctuating quantity which will give rise to a capacity current, depending upon the capacity between the three cores taken together and the sheath. The capacity of the Dublin cables, connected two in parallel, amounts approximately to 1.5 microfarads, and according to Mr. Tatlow, the currents in the earth wire might be of the order of one ampere. He suggests that this deduction could be tested easily by bringing the coil connected to a telephone near to the earth wire, and observing the pitch of the note in the telephone.

New York State Independent Telephone Association.

The annual convention of the New York State Independent Telephone Association will be held at Buffalo, N. Y., June 23 and 24. A number of addresses will be made by prominent telephone men and it is expected that a representative gathering will be present.

Report of the Canadian Commission on Electric Smelting.

Dr. Haanel, the Canadian superintendent of mines, who, with several other commissioners, was sent to Europe by the Dominion government to investigate the economic possibilities of electric smelting of ores, has made a preliminary report to the minister of the interior. An abstract of this is given in *Engineering* (London), May 27. Dr. Haanel pronounces the process both economical and simple, and recommends its adoption in Canada. The most important experiments witnessed by the commission were those at Sivet, France, where nine tons of ore were used to demonstrate the economic production of pig iron by the electric process. The furnaces used for these experiments were those used in the regular work of the company for turning out by the electric process the various ferros, such as ferrosilicon, ferrochrome, etc. This furnace is of the resistance type, consisting of two iron castings of square cross-section, forming two shafts communicating with each other at their lower ends by means of a carbon block. Electric connection is made to these blocks by means of copper bars. The carbon electrodes to which the current is distributed pass through two-thirds of the length into the shaft. Different classes of pig iron were obtained without difficulty, and the furnaces worked throughout the experiment quietly, the gases discharging in flickering flames, showing a low pressure. The men employed were ordinary laborers without special training. The castings showed sharp edges, a comparatively smooth surface, and were uniform throughout. The energy absorbed per ton of pig was found to be 0.226 horse-power-year. The approximate cost of producing a ton of iron is given in detail, the principal items being the cost of the ore, $2.76; coke for reduction, $2.31; electrical energy at $10 per horse-power-year, $2.26. The other items bring the total up to $10.60, exclusive of royalty. Dr. Haanel is of the opinion that the electric process opens up great possibilities in Canada, as the Dominion is rich in iron ore.

Study of the Primary of an Induction Coil by Means of Hospitalier's Ondograph.

An interesting investigation of the behavior of an induction coil has been made by MM. André Broca and Turchini, by means of a Hospitalier ondograph. Difficulty was first met in obtaining a suitable interrupter. One of the Villard type, consisting of a rod plunged into mercury, was tried, but without satisfactory results. However, an interrupter consisting of a mercury turbine has given entire satisfaction. The forms of curve obtained are shown, but these do not agree with the values obtained by computing the time constant of the coil. The curve showed that the maximum electromotive force did not occur when theoretically it should, but was retarded about one-two-thousandth of a second. Tests on another coil gave agreeing results. It was found that the difference of potential at the terminals of the condensers follows an undulating curve which never attains zero, and which has nearly exactly the same period as that of the difference of potential at the terminals of the primary coil.—*Bulletin de la Société Internationale des Électriciens (Paris), April.*

TIN SCRAP RECOVERY PROCESSES.

BY JOHN B. C. KERSHAW.

The electrolytic treatment of tin scrap and of tin slags has become in recent years a well established and progressive minor electrometallurgical industry. According to recently published reports, Germany

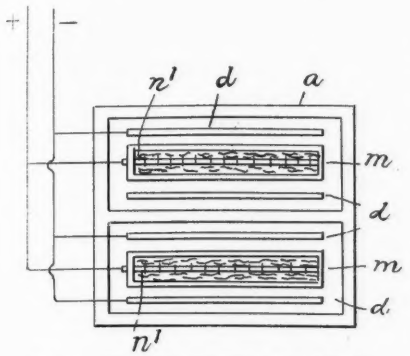


FIG. 1.—THE GELSTHARPE TIN SCRAP RECOVERY VAT.

possesses eight factories operating such processes, and treats 30,000 tons of tin scrap annually in this way.

Since the average amount of tin in this hitherto wasted material is only about 3.5 per cent, the 30,000 tons of scrap are reduced to under 1,000 tons of tin when the recovery is completed. But the iron remaining after the tin has been stripped from the cuttings and scrap is in some cases sold for resmelting, and the total value of the annual production of this industry in Germany is, therefore, well over $600,000. Electrolytic recovery works for treating tin scrap have also been erected in Austria, in England and in America, and the industry is therefore worthy of the attention of readers of this paper. In the following article details will be given of all the processes which have attained industrial trial; followed by some remarks upon operating cost, and upon the future of the industry.

THE CLAUS PROCESS.

This process is protected by British patent No. 297 of 1895, and a company was floated in London in August, 1896, to operate the Claus process upon a commercial scale. As described in the patent specification, the tin scrap was employed as anode material, in a bath containing sulpho-stannate of sodium as electrolyte, of Sp. Gr. 1.070, and heated to about ninety degrees centigrade. A current density of ten amperes per square foot was recommended; the cathode material was not specified. Should the deposited tin contain antimony or arsenic, these impurities were to be removed by a second electrolytic treatment, in which the tin first deposited was employed as anode, in a bath composed of dilute hydrochloric acid, containing hyposulphite of soda. Under such conditions of electrolysis, the antimony and arsenic were said to be precipitated as sulphides, and only the tin was deposited in the metallic state at the cathode.

As already stated, the Claus process was operated industrially in London about 1898, but nothing has been heard of the process for several years; and the writer believes that the works were closed owing to lack of financial success.

THE GARCIA PROCESS.

This process is protected by British patent No. 18,726 of 1890, and was operated in London about 1891. A pure solution of ferric chloride was employed for dissolving the tin, this operation being carried out without the aid of the electric current. Several methods were given by the inventor for preparing this solution of ferric chloride from the residues left after dissolving the tin; and stress was laid (wisely) upon the great importance of obtaining a pure product, in order to maintain the solutions intended for electrolysis in a suitable condition for producing good deposits of tin. The cuttings were contained in crates holding 250 kilogrammes each; and solution of the tin was obtained by immersion of the scrap in the hot ferric chloride solution; three minutes being said to be adequate for this operation.

The solution of ferric and stannic chloride obtained in this way was then filtered, carbolic acid and sulphuric acid were added in proportions definitely stated in the patent specification; and electrolytic deposition of the tin was then carried out, with anodes of carbon and cathodes of lead. The deposited tin was washed with water, and finally with petroleum, before casting into ingots. The Garcia process was operated in London about 1891, but was not a success; probably the cost of the carbolic and sulphuric acid added to the electrolyte being the cause of financial loss.

THE GELSTHARPE PROCESS.

This process is protected by patent No. 2,282 of 1901, and has been operated upon a commercial scale in Manchester. The cuttings, packed in wooden crates each holding fifty-six pounds, were employed as anodes, in a bath containing a 1.25 per cent solution of hydrochloric acid, with a small amount of sulphuric acid as electrolyte. Tinned sheet was used as cathode material, and the deposited tin, after washing, was melted in a furnace of special design.

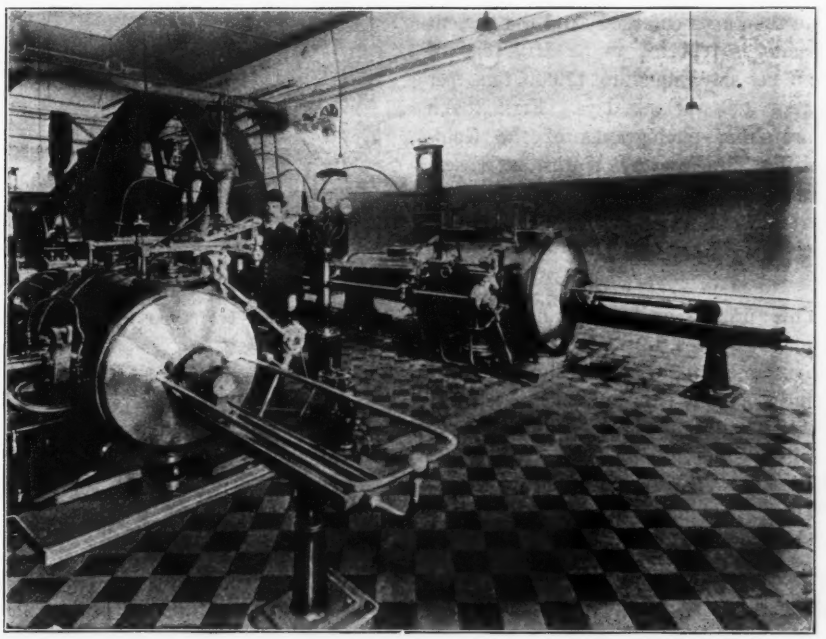


FIG. 2.—THE GENERATING MACHINERY AT THE GOLDSCHMIDT TIN-RECOVERY WORKS, ESSEN, GERMANY.

The iron remaining after removal of the tin was worked up into crystalline ferrous sulphate. Fig. 1 is a sectional plan of the Gelstharpe vat, containing two anode crates (n') and four cathodes (d). This process was operated at Manchester during 1901 with a small plant, and sixty tons of cuttings and scrap were passed through the recovery operation. A direct-

current dynamo, producing 1,500 amperes at five volts, was employed for current generation, and four stripping tanks, worked in parallel, formed the depositing plant.

The writer is unable to say whether this process has undergone industrial development; but it will be apparent from the figures given in the concluding section of this article, that none of the processes using acid or a mixture of acids as electrolyte, and producing ferrous sulphate or chloride as a by-product, can hope for permanent success.

THE GOLDSCHMIDT PROCESS.

This process has been operated in Germany for some years at the old-established chemical works of Th. Goldschmidt, at Essen, on the Ruhr. No details of the process (which has not been patented in England or America), as worked at Essen, are available for publication. The writer believes it to be, however, an alkaline process; sodium hydrate being used as electrolyte, and the tin scrap, contained in iron baskets, being made anode in this solution in the usual manner.

The tin-recovery works at Essen have been very successful—the plant has been more than once enlarged; and the present capacity is reported to be fifty tons of scrap per day, equal to 15,000 tons per year of 300 working days. Figs. 2 and 3 are from photographs of the Goldschmidt Tin-Recovery Works, at Essen, and show the generating machinery and the storeyard for the tin scrap as it is received into the works.

THE LEAVER PROCESS.

This process is undergoing development at Swansea, in South Wales; a company named the British Electric Separating Company having recently been registered for this purpose in London. No details of the process are available for publication; British patent No. 11,312 of 1901, in the name of H. A. Leaver, being for a non-electrolytic process of recovery. The latest information received by the writer is to the effect that the company is undergoing reconstruction, and that the capital is to be increased to $150,000.

THE SMITH & GUTENSOHN PROCESS.

This process is protected by German patent No. 12,883, and has been operated in Milan, Italy, and in London. The scrap was packed in wooden trellis work baskets, and was immersed in an electrolyte, composed of dilute sulphuric acid (one in ten) and tin sulphate. The scrap was made the anode, and tinned copper sheets were used as cathodes, the distance separating anode and cathode being four inches. An electromotive force of 1.9 volts was required, with a current density of nine amperes. The iron dissolved in this electrolyte as well as the tin, and after seven weeks' use it became fully saturated with ferrous sulphate. As already stated, this process received industrial trial in London and in Milan, but in neither case was permanent success attained. The failure in Italy, between 1885 and 1890, was attributed by Dr. Smith to bad management and to lack of capital; and as the tin scrap was said to cost practically nothing in that city, this surmise may have been correct. In London, where the process was tried in 1890, the failure was reported by the same authority to have been due to the high cost of the scrap, as delivered in the works.

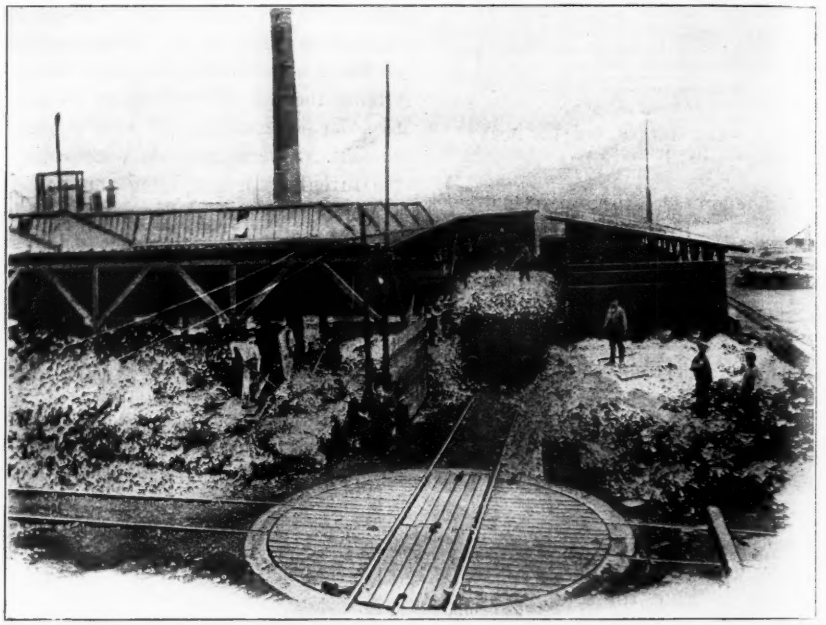


FIG. 3.—TIN SCRAP STOREYARD AT THE GOLDSCHMIDT TIN-RECOVERY WORKS, ESSEN, GERMANY.

OTHER PROCESSES.

A number of works and small plants have operated electrolytic processes for recovery of tin, from tin scrap and cuttings, which do not appear to have been patented. A French plant was reported to be using a sulphuric acid process some years ago; both the tin and iron being dissolved, and the tin electrodeposited, while the iron was recovered as ferrous sulphate. A plant using eight horse-power was erected for this trial; but it is unlikely that it attained any commercial success. At the electrometallurgical works of Nikolajev, at Nijni-Novgorod, in Russia, and at Crefeld, in Germany, electrolytic processes are reported to be in use, in which tin scrap is employed as raw material. At the latter place, tin chloride is produced for use in the silk works of the locality. No details of these two processes are, however, available for publication. In 1901 the Electrolytic Tin-Recovery Syndicate was registered in London, with a capital of $50,000. The process which this syndicate was to purchase and work was said to have been patented and tried with success upon a commercial scale. A plant capable of dealing with fifty tons of tin scrap per month was to be erected. No further details of this company or process have been published however; and it is not known in whose name the latter has been patented.

Several new electrolytic tin-recovery works have also been erected recently in Germany and Austria, and it is believed that all of these are employing the alkaline process of recovery, first patented by Beatson, in British patents No. 11,067 of 1885, and No. 12,200 of 1890.

In these patents, Beatson described a process for recovering tin from tin scrap, in which hot caustic soda solution of 1.210 Sp. Gr. was employed as electrolyte, and the scrap and cuttings were used as anodes in flat boxes having wire gauze sides. Fig. 4 is a section elevation of Beatson's vat, containing four anode boxes (*c. c. c. c.*) and four cathodes of thin iron plate (*d. d. d. d.*). In order to refine the tin obtained as a powdery deposit on these plates, Beatson pressed it into flat cakes, and employed these as anodes (*i. i.*) in a second depositing vat, shown in Fig. 5. A strong solution of stannous chloride or sulphate was employed as electrolyte in this case, and a revolving cathode of iron

or tin was used to receive the deposit, a pressure roller being employed to obtain this deposit in a more dense and solid state. The tin obtained in this way was finally melted and cast into ingots. This process has undergone certain modifications at the hands of those who are now employing it; but in its essentials it is practically that patented by Beatson over nineteen years ago. As worked in Austria at the present time, a solution containing from ten to twenty per cent of caustic soda is employed as electrolyte at a temperature of between sixty and seventy degrees centigrade; and a current of 800 amperes at eight volts is said to suffice for the treatment of from ten to twelve and one-half tons of scrap per week. An electromotive force of 1.5 volts is required, with scrap containing seven per cent of tin at the temperature of between sixty and seventy degrees centigrade. This electrolyte only dissolves the tin, the iron is left practically unattacked, and in a condition suitable for smelting operations. The Bremer-Metallwerke, at Hemelingen, in Germany, and the Chem. Fabrik Elektron, of Pfaffstätten, and the Chem. Fabrik Schefftel, of Floridsdorf, in Austria, are employing this process for stripping tin from tin scrap; while in England, the firm of Batchelor & Company, of Birmingham, and two other firms, are carrying on similar works. No details of the processes used in the latter are, however, available for publication.

An electrolytic process, in which tin slag is employed as raw material in place of tin scrap, is operated at Tostedt, in Germany, by the firm of Robertson & Bense. This process is described in British patent No. 14,325 of 1897, granted to E. Bohne, and depends upon treatment of the granulated slag with dilute sulphuric acid, and upon recovery of the dissolved tin from this solution by electrolytic deposition. The silicious slag residues which still contain tin are used to form the hearths of the smelting furnaces; and this tin thus enters the process again at another stage.

OPERATING COSTS.

The cost of the electrical energy required to deposit tin from the sodium stannate solution obtained, when tin scrap is employed as anode in a bath of sodium hydrate, is comparatively of little account, when one bears in mind the value of the recovered tin. Thus a current of ten amperes at one and one-half volts will deposit 11.12 grammes of tin per hour, from a sodium stannate solution of seventy degrees centigrade with tin anodes. One kilowatt-hour will therefore yield 733 grammes of tin at the cathode.

Taking an average energy efficiency for the alkaline recovery process of sixty per cent, we find that one kilowatt-hour will yield 440 grammes of tin, or that 2,500 kilowatt-hours will be required to yield 1,000 kilogrammes (one metric ton) of pure tin. Assuming the cost of power to be one penny per kilowatt-hour, the cost of electrical energy per ton of recovered

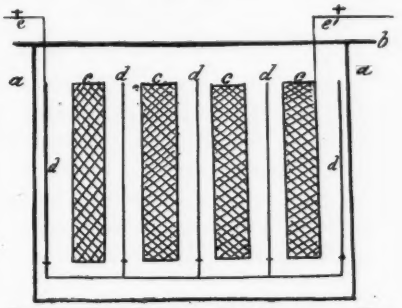


FIG. 4.—THE BEATSON TIN-STRIPPING VAT.

tin is found to be only £10 8s., or less than nine per cent of the present market value of the metal.

The sodium hydrate employed as electrolyte can be used for a lengthened period before the accumulation of impurities in it necessitates its renewal; and therefore the actual running costs of the alkaline electrolytic tin-recovery process are remarkably low. The difficulties of the process arise chiefly in connection with the

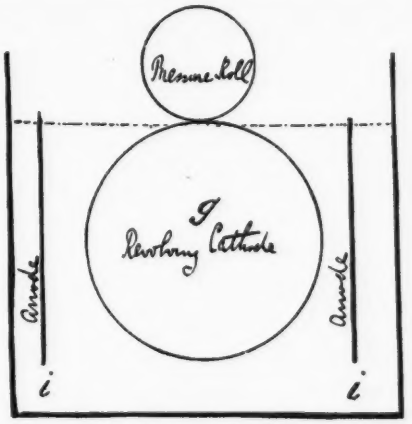


FIG. 5.—THE BEATSON TIN-REFINING VAT.

working up of the deposited tin. This deposit is spongy in character, and is therefore troublesome to deal with in the after-smelting operations necessary in order to obtain the tin in ingot form. No details have been allowed to leak out concerning the methods used, but it would seem probable that the spongy tin is first subjected to mechanical pressure, and is then melted in the presence of some inert gas, or in a vacuum. Some loss of tin in the form of oxide or dross is likely to occur in the process. However, even when allowing ten per cent for the losses incurred while obtaining the deposited tin in ingot form, the alkaline electrolytic tin-recovery processes ought still to yield a handsome profit when the cuttings and scrap are obtained at a reasonable cost for collection and carriage, and when a market can be found in the locality of the works for the remaining iron. The acid tin-recovery processes are less favorable as regards running costs, for the acid is not renewed as in the case of caustic soda, but is used up in dissolving the iron, and the saturated solution of ferrous sulphate or chloride ultimately obtained is not likely to prove a very valuable by-product. Since tin scrap contains on the average only 3.5 per cent tin and 96.5 per cent iron, much more ferrous sulphate is produced by the acid process than metallic tin. Assuming that only fifty per cent of the iron is dissolved by the acid for each ton of metallic tin recovered, at least twenty-nine tons of scrap will be worked up, and seventy tons of crystalline ferrous sulphate will be produced.

The market for ferrous salts is however limited, and this fact explains the failure of many of the acid tin-recovery processes which have received industrial trial.

THE FUTURE OF THE INDUSTRY.

The alkaline electrolytic process for recovery of tin from tin scrap and cuttings is one which is likely to expand into an industry of considerable importance. In most large cities the collection and sorting of the refuse and garbage will, in time, be carried on under municipal control; and as the use of tin cans for foods is now so general, the amount of tin that could be obtained annually from the rubbish and garbage of our modern cities is much larger than is yet realized. The present methods of collection and despatch of this tin scrap to the German and other foreign recovery works are, however, costly. It seems probable that the line of future development will be in the direction of tin scrap recovery plants, worked as an adjunct of all large electric supply stations. These plants would help to provide the electrical engineer with a day load for his plant; and would only require a chemist and a few laborers for their operation and control. Since the plant would draw only upon the local supply of tin scrap and cuttings, the charge for collection and cartage would be low; and a tin scrap recovery plant working under such conditions would be more likely to yield a profit

than under the present arrangements in this industry.

As regards the demand for raw material and price, there is reported to be a steady export of tin scrap from the Atlantic coast to Antwerp for supply of the German works; and Messrs. Batchelor & Company, of Birmingham, also report that there is considerable difficulty in obtaining supplies of cuttings and scrap at present, owing to the competition of the foreign buyers. In 1898, the average value of the scrap in New York was reported to be $5 per ton; while in Liverpool the writer has been recently informed by the city engineer that only 2s. 6d. per ton is obtained for the scrap at the municipal depot.

A recovery works, situated in France, was reported to have been abandoned in 1899, owing to the difficulty of obtaining regular supplies of the raw material, and two of the German works are also reported to have failed from a similar cause. The cost of freight must add greatly to the cost of scrap used in the German and Austrian works, and it is therefore in the highest degree unlikely that the industry will remain as, at present, practically a German industry; and that America, England, France and Switzerland will continue to send scrap and cuttings to Germany for recovery of the tin they contain. The chemists and electrical engineers of this country might, therefore, with advantage, give their attention to the possibilities of the industry.

Abyssinian Telephones.

The Washington (D. C.) *Post* published recently an interview with an American engineer who has been employed in erecting telephones in Abyssinia. He states that there are, at the present time, nearly 800 miles of telephone wires already erected, and about a thousand miles in course of construction. The work is being done for the Abyssinian government, and the contractor has had almost every imaginable trouble to contend with. Tremendous rainfalls were the first source of damage, washing out many miles of pole line. Scarcely had this damage been made good when the poles again began to fall. This time the cause was termites, or white ants. The destruction was stopped by erecting iron poles, but the latter proved very attractive to the natives, who tore them out and converted them into tools. To put a stop to this, messengers were sent throughout the country, proclaiming that extreme punishment awaited any who touched the telephone lines.

The principal trouble encountered now are elephants, who use the telephone poles as scratching posts, thus knocking them down, and monkeys, who find the wires delightful swings. The rapid growth of the jungle also gives some trouble and makes it necessary to keep a party of men constantly employed cutting away the young growth.

Electrical Notes from India.

The Mysore state government has sanctioned the proposal to supply electric light and power to the city of Bangalore from the generating station of the Cauvery power scheme, located at Sivasamudram. However, the proposal must yet be approved by the government of India, though it is highly improbable that any obstruction to the passage of the same will be forthcoming.

A separate transmission line will be constructed between Sivasamudram and Bangalore, running parallel with the existing line to the Kolar gold fields, as far as the first section-house, located at Kankauhalli. The length of the proposed line to Bangalore is some sixty miles, and will be operated at a pressure of 35,000 volts, which is the same as that employed on the ninety-two-mile transmission line to the gold fields.

Distribution for light and power within the city limits will be effected by two or more substations, to which current will be transmitted at 2,300 volts from a central step-down transformer station. The steel tower system of street lighting will be used in those parts of the city which are free of high buildings, thick growths of trees and other like obstructions.

It is not improbable that the city of Mysore, which is the thriving capital of Mysore state, may also be supplied with a system of light and power from the Cauvery Falls power station. The city of Mysore has a population of about 80,000. The distance from Sivasamudram to Mysore is some forty miles. The accompanying sketch shows roughly the existing transmission line to the Kolar gold fields, and the proposed and probable future lines to the cities of Bangalore and Mysore respectively.

Much annoyance and inconvenience have been caused recently by natives who have conceived the idea of stealing several spans of copper wire from the telephone lines, which established communication between Bangalore, Sivasamudram, Kolar gold fields and intervening stations on the transmission line. The natives have a great liking for copper, since it forms a part of their wearing apparel, as jewelry for the ears, nose, toes and arms. The police have repeatedly failed to capture the guilty parties; so the ever useful electrical remedy is now being employed. From 6.30 P. M until 6 A. M. a pressure of about 1,000 volts is employed on the line, all telephones being disconnected therefrom. If telephone communication is desired at any point on the line, the operator on duty at the generating station is made aware of the fact by means of a signal lamp, which becomes extinguished by the blowing of a fuse at the latter place. The person desiring to talk, signals the operator at the generating station by short-circuiting the telephone line, thus blowing the fuse and extinguishing the signal lamp. The operator then disconnects the high voltage from the telephone line for the time being. This may seem to be rather a drastic remedy to employ, but it offers the only means of effecting a cure for all time.

A 1,000-horse-power, steam-electric power plant is being constructed on the Kolar gold fields in addition to the ultimate 6,000 horse-power available from the plant of the Cauvery Falls power scheme. This plant is to furnish power for operating hoists and the entire lighting system on the gold fields. The units to be employed are direct current, direct-connected for lighting with motor-generator sets for supplying alternating current to the induction motor-driven hoists. Speed variation for the hoists is obtained by rheostatic control of the rotor resistance. The territory to be lighted is from five to six miles long by about one mile wide.

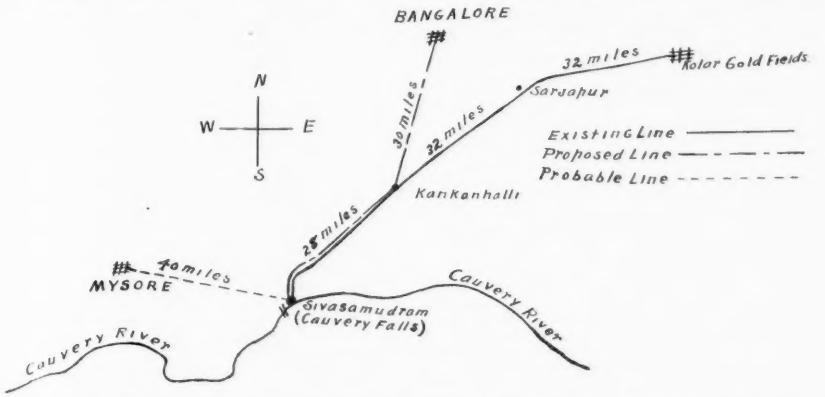
The fact that an auxiliary steam-driven electric plant is being installed in a place where coal costs from five to eight dollars per ton, speaks volumes in favor of the employment of electricity in mines wherever it is at all practicable to do so.

A project which has been given some consideration and which is quite feasible, is the electrification of the Kolar gold fields railway. This is a branch road, some seven or eight miles in length, traversing almost the entire length of the gold fields and forming a junction with the Madras railway at Bowringpet. This small branch road, in addition to handling the large quantities of freight and supplies for the gold fields, has quite an extensive passenger traffic. Undoubtedly the service could be improved in every way by converting it into an electric road. The necessary power is obtainable at a rate which should make it economical to do so.

Though Mysore state has taken the initiative step in the advancement of electrical engineering projects in India, minor installations are being proposed or are already under way in some of the other provinces.

It is proposed to install an electric power and lighting plant near Srinagar, Kashmir, in the northern part of India. A fall of some 200 feet is obtainable from

the Sind river, from which the water supply is ample at all times of the year except for a very short period during the winter months when only about 300 horse-power is available. Power is to be transmitted at a pressure of 10,000 volts from the generating station, near Ganderbal, to the city of Srinagar, a distance of twelve miles. The voltage is to be reduced to about 2,000 at a central step-down transformer station, located outside Srinagar. From this station, power will be transmitted to four or more substations, located in different parts of the city, at which points the voltage will be reduced to meet the requirements. Seven hundred horse-power will be delivered in Srinagar, but the plant will be arranged for a future supply of 1,000 horse-power. The cost of the scheme is estimated at about $200,000.



Sketch Showing Existing Transmission Line and the Proposed and Probable Extensions to the Cauvery Falls Power Scheme, Mysore State, India.

Another project outside Mysore state, which has been given some consideration, is the electrification of the Nilgiri railway, located in southern India. This is a branch road some thirty miles long having for its terminus the hill station, Ootacamund. The road has an approximate grade of four per cent and it is thought that sufficient water power is available for its successful operation by electricity. The successful solution of the problem, of course, entirely depends upon the latter condition.

Thus it will be seen that an unusual interest is being taken in electrical projects in India, and the latter is already playing no small part in the development of the resources of the country.

A. C. H.

Sivasamudram, India, May 4.

The St. Louis *Star*, a daily evening paper, is receiving a wireless news system from the World's Fair, utilizing the De Forest apparatus which has been set up on the grounds.

MANILA'S TELEPHONE SERVICE AND CONDITIONS.

BY ARTHUR STANLEY RIGGS.

There is an ancient Spanish proverb, seldom heard in Manila but much observed, which says: "Poca barba, poca sober," or, "Little beard, little wisdom." Unkind and self-centred Americans, engineers among them, have declared the old *fraile* (priest who belongs to one of the religious orders) who wrote the saw was thinking of the Filipino and his habits.

The capital city of the archipelago is the only one whose service has come into general condemnation and, in fact, it is the only one in which there is any public system, except the government's military (Signal Corps, U. S. A.) lines. Equipped with exceedingly ancient Ericsson or Spanish apparatus, with a makeshift switchboard having none of the facilities of a modern exchange, the "red telefonica" or "telephone network," as it is called, is usually in difficulties of some kind, and is operated by native and nestizo (half-breed Spanish-Filipino) operators. Working under a practically exclusive franchise from the Spanish government (which we are bound to respect), the company may retain its rights and privileges eight years longer, "provided a satisfactory and proper service be maintained during such time." But right there the people say they want a new service.

The service, as a matter of fact, is so bad that the following incident will illustrate it more aptly than any mere superlative. A well-known promoter and former United States consul was trying one day to call up a certain newspaper in the walled city from his office over the river in Binondo, the Chinese quarter. He rang steadily, and three friends dropped in, one by one, chaffing him about "central." After about ten minutes he requested one of the gentlemen to keep up a steady ringing, and said he would drive over to the "red."

The friend took the receiver and began ringing, and Mr. J—— jumped into his *carromata* and dashed over to the walled city. In less than ten minutes his voice came over the wire, fairly sizzling, yet triumphant.

"Hello! that you F——? This is J——. Yes, the 'red'; what do you suppose I found this black d——l doing? He was lying back in his chair, reading a paper and smoking, had his feet on the table of the board. One bare toe was keeping the drop of my line up, and he used the other foot to snap up the other drops as fast as they fell."

"Huh! What's that? Yes, I certainly did. I fixed that 'gugu' all right, but I can't reach the others."

At night, as the writer knows by sad experience, the operator frequently grounds or cuts out a line that is at all apt to keep him busy. Between nine and midnight the wires of the *Cablenews* and *American*, Manila's two large dailies, are frequently cut out for hours at a time, so that not only is it impossible to get central, but impossible to make a sound with the ringer in the office. Judge H. C. Ide, commissioner of finance and justice in the Philippines, told the writer one day that aside from the bad service already detailed, his telephone had the bad habit of going off by itself at all hours of night or day, so that about one-fourth of the calls in his house were mere false alarms. For that reason, he said, he had ordered the company to take its disturber away, but, with the listlessness of most such concerns in the tropics, they had not done so up to a very recent date.

Several attempts have been made to get an American company with good apparatus and operators to enter the field. The cost of installation is very high. American or good Spanish operators would have to be paid large wages merely to enable them to live and work, and the government has not made concessions of the sort that would enable a reputable company to do a legitimate business. Besides all this, at least two-thirds of Manila's white population believe another uprising is coming, and may be here within a year or two. Conditions are too complex to be detailed here, but it is safe and conservative to say that never before have the natives been so sullen and ugly, and that if they get a leader who can command them there will be trouble which could result only in the damage or destruction of all property, like telephones and telegraphs. The time is not yet ripe for the introduction of really American conveniences involving heavy expenditures and engineering difficulties, so for the present, at least, the white man who sickens under the fierce glare of the watery sun in that mucilaginous climate must go on making the best of the evils and inconvenience he finds all about him, waiting hopefully for what may come—perhaps when he has left.

DIRECT-CURRENT SYSTEMS OF ELECTRIC DRIVE.[1]

BY W. A. DICK.

The pertinent question regarding shop drive at the present time is not whether an electric system should be installed—no one now thinks of equipping a manufacturing plant of any size without such a drive—but what particular system should be used? No one system—direct-current or alternating-current, constant-speed or variable-speed—is of universal application. And as the product from each plant varies, involving different processes and tools, so to a certain extent must the method of drive vary. The object of the present paper is to describe the various direct-current systems, explain their characteristics, and indicate their advantages and disadvantages.

CONSTANT-SPEED SYSTEM.

The older installations are almost entirely constant speed and usually are of the so-called group-drive, each motor driving a section of shafting to which a number of tools are connected by belts. This method is yet common and in some cases the most desirable. Exceptions to this method occur in the case of very large tools where a motor would be used for each tool, still, however, driving them from a counter-shaft. It can readily be seen that it is only a step from this to putting the motor on the tool itself. We then have individual motor drive, and the tendency has been to extend this arrangement even to many of the smaller tools. For a large percentage of the motor drive usually required, a constant motor speed only is necessary. This application is comparatively simple and needs no discussion.

The methods in common use of joining motors to the driven parts are by belts, gears or direct connections. There are always, however, a large number of tools that require a variable speed. A constant-speed motor driving these necessitates some form of mechanical speed-changing device, such as cone pulleys, gears, Reeves pulleys and the like, for getting the different speeds. A vast amount of ingenuity and inventive skill has been employed in developing these mechanical devices and several are now on the market which are fairly satisfactory. One drawback to all, however, is the time required to make the speed changes. It is seldom possible to place these devices near the point where the work is being done, and in some of them the machines must be stopped to make a speed change. Experience has shown that these reasons prevent changes being made to the extent they should be made to get a maximum amount of work, and the result is a less output from the shop or factory.

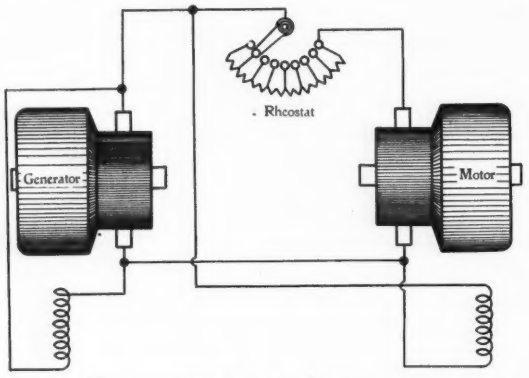


FIG. 1.—VARIABLE VOLTAGE BY ARMATURE RESISTANCE.

VARIABLE-SPEED SYSTEMS.

The desirability of getting a variation in speed from the motor itself and doing away with these mechanical devices obviously presents itself and has resulted in the development of a number of variable-speed motor systems. One advantage of getting the speed variations from the motor, instead of by mechanical devices, is that the machinist controls the speed without leaving his position, and this facility with which speed changes are made results in a largely increased output.

There are in general two classes of service requiring variable-speed motors. In the first and probably largest class the output of the motor remains practically constant over the entire range of speed, *i. e.*, the torque varies inversely with the speed. In the second class the output of the motor varies with the speed. In some cases it varies directly with the speed, *i. e.*, the torque remains constant; in other cases the output increases faster than the speed.

As the speed of a motor is almost directly proportional to the impressed electromotive force, it follows that a variation in speed can be obtained by varying the electromotive force. This method was the first adopted and it is still in use. Shunt field control obtained by varying the magnetic field strength by resistance in the shunt field windings is also largely employed. The number of voltages actually employed has been gradually decreased until at the present time the commercial systems in general use employ from two to six, all combined with more or less shunt field control. There are also one or two systems using a single voltage.

Reference is made in what follows to "balanced" and "unbalanced" systems or circuits. A word as to the meaning of these terms may not here be out of place. A balanced system may be defined as one having similar electrical conditions on the separate circuits. In an unbalanced one the electrical conditions are not the same. Any unbalance in the systems referred to will be represented in amount by the current flowing in the neutral or intermediate wires.

Variable Voltage by Armature Resistance—This is the earliest system and is still in use to-day for certain kinds of work. The voltage at the terminals of the motor is varied by connecting more or less of an ohmic resistance in the armature circuit, as shown in Fig. 1. This method is in universal use on cranes and street cars, and has a somewhat

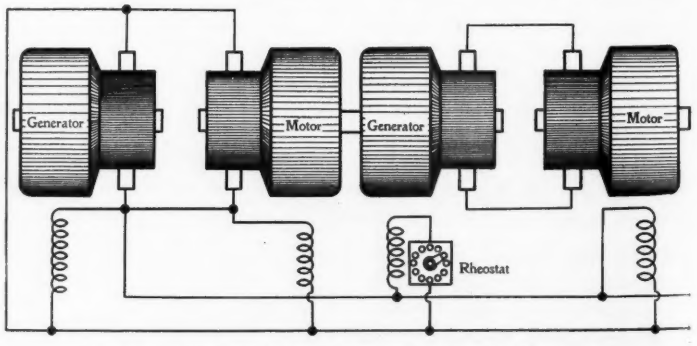


FIG. 2.—VARIABLE VOLTAGE FROM A MOTOR-GENERATOR.

[1] *Electric Club Journal*, June, 1904.

limited application with printing-presses, fans, pumps and blowers. It is particularly well adapted for intermittent service with series motors; it permits the smallest possible motor to be used and it is therefore the cheapest. Its disadvantages where constant speed is required with varying load, is poor regulation. It is also a very inefficient method, as all the energy taken up by the series resistance is lost.

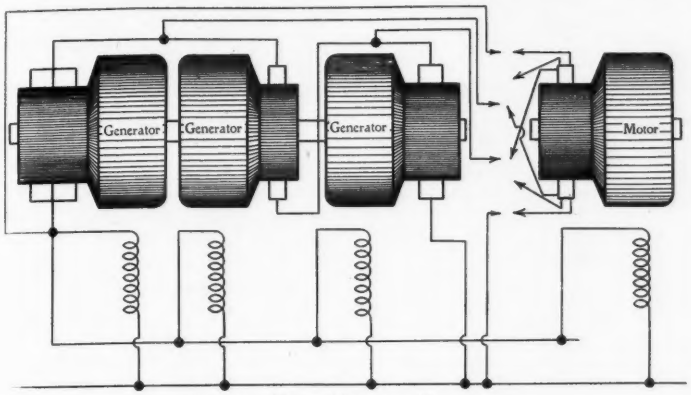


FIG. 3.—MULTI-VOLTAGE SYSTEM.

Variable Voltage from a Motor-Generator Set—To avoid the losses incurred in using armature resistance, a system has been developed consisting in the use of a generator with each motor, this generator being so designed that its voltage may be varied over wide limits, thus supplying a variable voltage to the motor terminals, which are wired direct to the generator. It is shown in Fig. 2. Although this system is ideal in many ways and is capable of very wide application, its actual use is very limited. It is particularly suited to work where constant torque is required of the motor, where the same size of motor frame can be used as with the "armature resistance" method. In case, however, constant output over the entire range of speed is necessary, a larger frame is demanded with larger commutator and brush capacity. The motor must be large enough to give the required output at the minimum speed and the commutator of sufficient size for the largest current.

This system gives a wide speed range and perfect control with any desired number of speed notches. The main disadvantage of its use lies in the cost of installation, which is excessive, as three machines are required for each motor application. To this fact almost entirely is due its very limited application.

Multi-Voltage System—The so-called multi-voltage, or four-wire, system, is an attempt at an approximation to the above system. It is capable of general application. Instead of a large number of different voltages obtained from a generator, it employs six, usually varying in arithmetical ratio from a minimum of forty up to the usual line voltage of 240. (Fig. 3.) These voltages can be obtained from any two-wire system by means of what is commonly known as a motor-generator or balancer set. This consists ordinarily of three machines coupled together and connected in series across the line. Two extra wires are brought out between the machines which are wound for the different voltages desired. By combination of the voltages obtained from these machines, six are available for use with the motor. It is much cheaper to install than the motor-generator system, as a single balancer set can be made to do for any number of motors. Its undesirability lies in the cost of the balancer set, which is high owing to the special characteristics of the machine; and the cost of wire, which is high, owing to the fact that four wires must be put in throughout the entire installation. These wires must be of comparatively large size. All the auxiliary apparatus, such as meters, circuit-breakers, switches, fuses, etc., must be for four wires. The system is an unbalanced one, rendering good regulation difficult. Poor regulation is also obtained on the motors at the low voltages owing to the heavy currents which must be used when constant output is required. This system involves in its latest developments the use of a small amount of shunt field control sufficient to obtain speeds intermediate between those obtained on the line voltages.

Unbalanced Three-Wire System—The next step in the evolution of variable-speed systems consists in the use of a three-wire unbalanced system from which three voltages are obtained. (Fig. 4.) It is much simpler than the multi-voltage system, involves only two machines for the balancer set, and the installation of but three wires with a correspondingly smaller amount of auxiliary apparatus. The middle wire must be comparatively large. Speeds intermediate between those obtained on the line voltages are secured by shunt field control.

This system has so far had a very limited application. It gives slightly better regulation than the multi-voltage system and is cheaper to install. On the other hand, one or both of the balancer machines must be special.

Balanced Three-Wire System—This is a three-wire system from which two voltages are obtained, one of which is one-half of the other. It is the ordinary three-wire Edison balanced system and is obtained either by two machines in series across the line or by the use of slip rings and autotransformers from a standard two-wire direct-current generator or rotary converter. (Fig. 5.) A three-wire system can also be obtained from a two-wire system by a balancer set consisting of two machines connected in series across the line. Fig. 4 also shows this arrangement diagrammatically.

The system consists of three wires, the middle or neutral wire of which can be comparatively small, as the system is much more nearly balanced than any of the others which have been described. Two voltages are available for the motors, and the speeds, aside from those obtained direct from the line voltages, are secured by shunt field control. This involves a

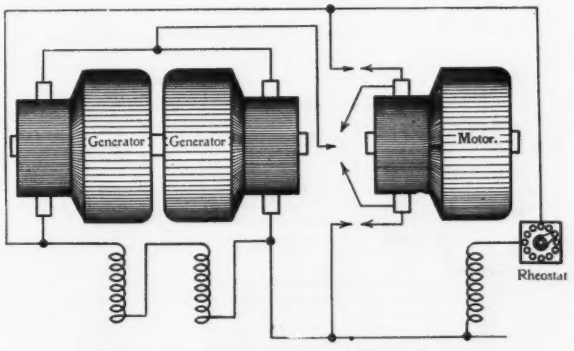


FIG. 4.—UNBALANCED THREE-WIRE SYSTEM.

wider speed range by field weakening than any of the systems previously mentioned. If the standard three-wire generator is used, the auxiliary apparatus to obtain the lower voltage is simple and one that requires practically no attention. Where two generators or a balancer set is installed these consist of two standard generators connected in series across the line. When a balancer set is used, these machines can be smaller on this system than any other. Motors, when properly installed, will be connected so that one-half will be operated for their slow speeds on one of the side circuits and the other half on the other side circuit. The maximum unbalance which can possibly be obtained is one-half of the machines on one of the side circuits. The maximum unbalance that can be obtained with the other systems is all the machines on any one of the voltages. In case of breakdown of the balancing apparatus, one-half of the total range of speed is available from the higher voltage. On all other systems only the maximum speeds from the highest voltage can be used. In an emergency any two similar generators or motors of any voltage having sufficient current capacity can be used as balancers. The objection most generally raised to this system is the extent to which the field weakening must be carried to secure the necessary speed variation. All systems use shunt field control. The amount of speed variation that may be obtained by shunt field control is merely a question of design. The bad effects do not come from the field weakening, but from the reaction of the armature upon the weakened field. If this armature reaction be prevented by suitable design, no trouble will be caused by the weakened field. The best answer to this objection is that motors operated with the amount of field weakening required by this system give satisfactory performance.

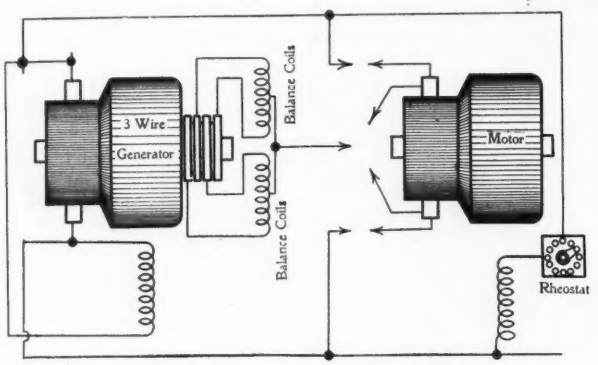


FIG. 5.—BALANCED THREE-WIRE SYSTEM.

Double-Commutator Motors—There are some cases where only one or two motors are to be installed, a two-wire system is available, and the expense of putting in a balancer set is such as to make a three-wire system objectionable. In such cases as this it is possible to use a double-commutator motor and obtain an exact equivalent of the results obtained with the three-wire systems. The armatures of these machines are provided with two independent windings and may be built in either one of two ways: first, by using two windings with a different number of turns in them, which is an exact equivalent to the three-wire, three-voltage system; second, by making the windings on the two ends of the motor the same and connecting them first in series for the slow speeds and then in multiple for the high speeds, in this way securing an exact equivalent of the three-wire, two-voltage system. Shunt field control is used in either case, the same as with the three-wire systems. The motor is longer than the single commutator machine and can not be placed so near to the work to be driven.

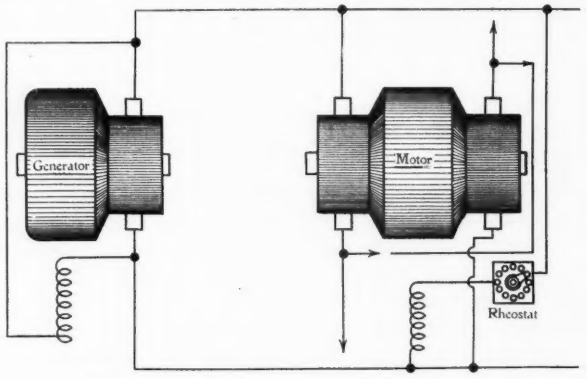


FIG. 6.—DOUBLE-COMMUTATOR MOTOR SYSTEM.

Single Voltage with Shunt Field Control—Standard motors of proper design will give a speed range of two to one, or even three to one in some cases on a single voltage with shunt field control. For speed ranges exceeding two to one there has recently been developed a system for single voltage work which is beginning to attract attention. Its application so far, however, has been small. It uses shunt field control and a so-called compensating winding in the fields as shown in Fig. 7. This method consists of threading through the poles a winding which is connected in series with the armature and so proportioned that the strength and direction of the field set up by this winding is opposite to that set up by the armature. The effect of this winding is to neutralize the armature reaction. By the use of this system the field strength of the motor can be varied over a wide limit without seriously affecting commutation.

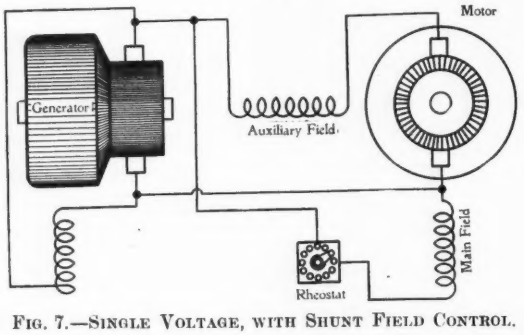


FIG. 7.—SINGLE VOLTAGE, WITH SHUNT FIELD CONTROL.

In considering the different systems of variable speed motor-drive, attention is at once directed to the evolution that has taken place. Starting with complicated and expensive systems, there have been evolved arrangements comparatively simple. The number of voltages has diminished so that the bulk of variable speed work is now done with one or two voltages, while the auxiliary apparatus and the cost of installation are much less than formerly; and these results have been accomplished without the use of excessively large motors. In all of the above systems the size of the motor is practically the same on the same basis of rating and speeds. The output and minimum speed fix the size of the motor frame irrespective of the system.

NOTES ON X-LIGHT.

BY WILLIAM ROLLINS.

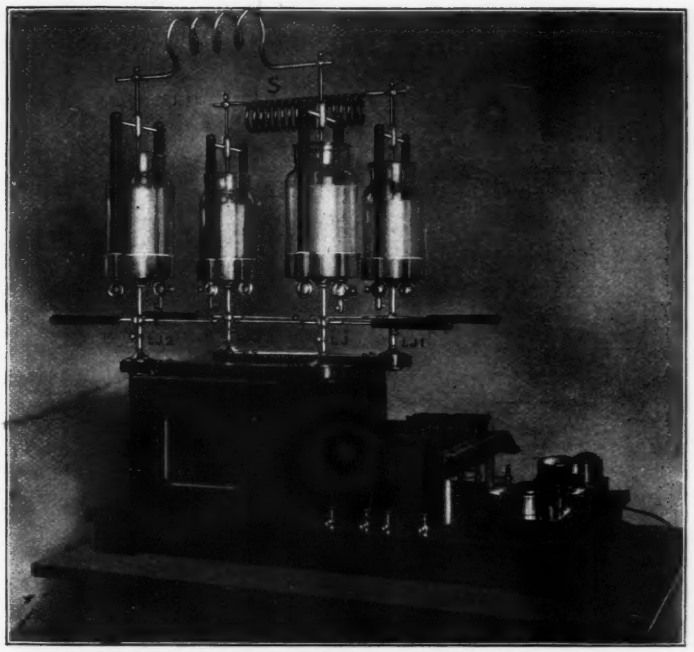
NOTE CLXXIXD2—ON THE CONSTRUCTION OF A TRANSFORMER FOR ETHER AND ELECTRON THERAPEUTICS.[1]

For making electrons by allowing short ether waves to strike a negatively charged body—(the electrons being used to ionize the molecules of skin diseases by placing a patient on an insulated platform and charging him positively as described in note clxxix)—the spark-gap of the transformer having aluminum terminals is mounted on an insulating handle to enable the physician to move the source of electrons freely.[2] The arc and shield being attached to the generator by flexible cables allow any part of the surface of the body to be treated. The arc may be placed at the focus of a parabolic shield mounted on the same insulating handle, the shield being connected with the negative terminal of the same source of electricity whose positive terminals charge the patient. Whether the shield takes the form of a parabola, a part of a sphere or a flat surface, the physician should be protected from the energy, as already insisted on in connection with X-light, derma rays and high-frequency discharges. Whatever form of energy is used in electrotherapeutics, it should be remembered ionization is the result to be brought about.

These hinged Faraday rings are also convenient means of lighting electrodeless vacuum tubes for general therapeutical purposes. One pole of the secondary may be attached to one end of a large solenoid whose other end is connected with the vacuum tube by a flexible conductor, the inner coatings of the Leydens being united and the spark-gap in the secondary circuit made too large for a discharge to take place between the terminals, the current going back to the other terminal through the ether silently and unguided by a wire. This method is illustrated in Fig. 13. It is useful among other things for treating dilation of the stomach and pulmonary tuberculosis. During these investigations it was sometimes found desirable to combine derma rays with these electrodeless vacuum tube treatments as in eczema. In these cases a derma-ray tube was substituted for the ordinary electrodeless low vacuum tube, the cathode of the derma-ray tube being

[1] This note began in the issue of June 4.

[2] When the transformer is used to develop ultra-violet light to be used directly or for the production of electrons, a large amount of irritating gas is produced by the combination of the nitrogen and oxygen of the air. A flexible rubber tube should have its open end placed near the spark, the other end being connected with an aspirator, which will remove the gas.



NOTE 179D2—FIG. 8.—HINGED FARADAY RING SHOWN IN FIG. 7, WITH THE SECONDARIES INDEPENDENT INSTEAD OF IN SERIES.

This is the same transformer shown in Fig. 7, but with the secondaries independent instead of in series. Each secondary will give sufficient voltage for the ultra-violet arc or the electron arc or for exciting derma-ray tubes. One secondary is provided with a Tesla coil, not shown in the photograph, the other with a solenoid (S). To provide spark gaps for the two independent coils the supports (LJ, LJ2, LJ3, LJ4) are pivoted to allow them to turn from the position shown in Fig. 7, in a horizontal plane ninety degrees.

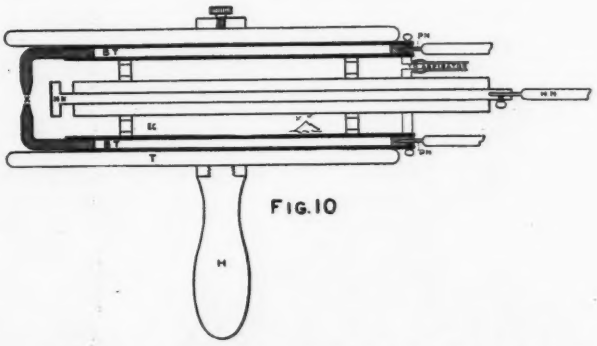


FIG. 10

NOTE 179D2—FIG. 10.—AN ELECTRON GENERATOR FOR USE IN THERAPEUTICS.

The illustration shows one of the forms of electron arc mentioned in earlier papers. The instrument is attached to the hinged Faraday ring, illustrated in Figs. 7 and 8, by flexible wire cables which are attached at P and N. The terminal HN is connected to the negative terminal of a high-voltage generator whose other terminal charges the patient positively. The patient is placed on an insulating platform. The arc formed by the current from the Faraday ring is between the aluminum terminals X. It is rich in ultra-violet light which, illuminating the face of the disk HN, causes it to send out electrons that bombard the patient's skin when the arc is placed near it, ionizing the tissues. The whole arc is enclosed in an insulating tube (T) provided with a movable handle (H), which allows it to be placed in any position near the patient. The aluminum terminals can be removed and others put in their places, as they are held in tubes (BT and BT).

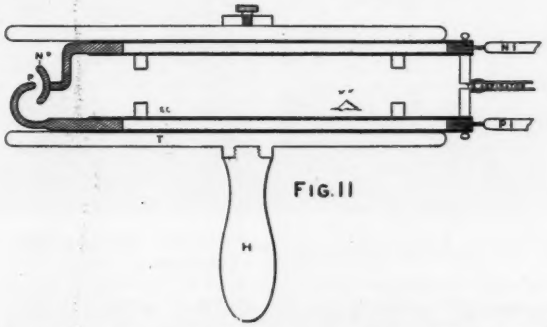
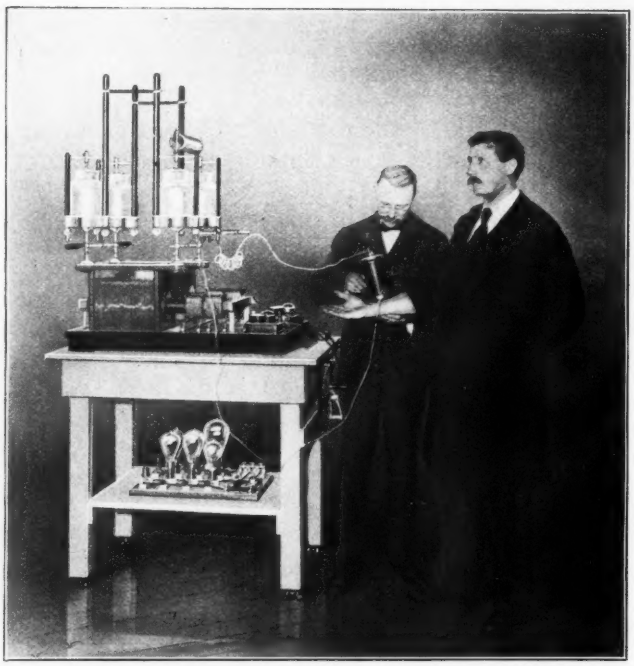


FIG. 11

NOTE 179D2—FIG. 11.—A FORM OF ULTRA-VIOLET ARC FOR USE IN THERAPEUTICS.

In this arc the negative terminal is a curved plate N, the positive terminal is a blunt hook P, both terminals being made of aluminum. The arc is enclosed in an insulating case T and provided with a handle to allow the arc to be brought near any part of the patient. The apparatus is connected with the generator by flexible wires attached at PI and NI



NOTE 179D2—FIG. 12.—A METHOD OF USING A DERMA-RAY TUBE.

The wires leading from the closed Faraday ring are attached to the terminals of the secondary at FT, the other ends being connected with the terminals of the derma-ray tube by means of the binding posts B. The derma-ray tube case DRC is lined with a heavy coating of non-radiable material, and the hand which holds the tube case is enveloped in a non-radiable glove.

NOTE 179D2—FIG. 13.—A METHOD OF USING THE HINGED FARADAY RING FOR EXCITING A VACUUM-TUBE ELECTRODE.

The solenoid BS is supported and insulated by the fibre rods FR, one end being connected with the secondary of the Faraday ring at FT. The other end of the solenoid is attached to a wire W, which is in metallic connection with the electrode vacuum tube EVT. As only one terminal of the secondary of the closed Faraday ring is connected with the vacuum electrode, the current after leaving the patient returns to the generator through the ether without a wire to guide it. Under these circumstances when the room is dark the generator sometimes presents similar appearances to those shown by the aurora. The simplest way to regulate the energy applied to the patient is to vary the current in the primary of the Faraday ring by means of a graduated resistance. The solenoid can be removed from the position shown and placed on the floor or in any other convenient position. Various sizes of these solenoids should be provided and used after French methods, both terminals being connected with both terminals of the secondary of the Faraday ring, the whole or any part of the patient being enclosed by the solenoid.

attached to one pole of the solenoid in the way shown in Fig. 13. The anode of the derma-ray tube had no metallic connection with the Faraday ring. When the derma-ray tube was brought in contact with the skin, in addition to the deeper effects obtained from an ordinary electrodeless tube, derma rays were produced for the treatment of the skin.

The usual way of attaching a derma-ray tube to the secondary of the Faraday ring by both terminals is illustrated in Fig. 12. With this method the amount of derma rays produced far exceeds that yielded by the tube when only terminal is connected, and many of the other electrical effects are too small to be considered. During these investigations a considerable number of other new electrical treatments have been used which will be described later if the matter is of sufficient interest to warrant taking the necessary time to write the descriptions and make the illustrations.

NOTE CLXXIXE—ON LIMITING THE SPACE OF STRAINED ETHER PRODUCED BY A WIRE GUIDING AN ELECTRIC CURRENT USED IN ELECTROTHERAPEUTICS.

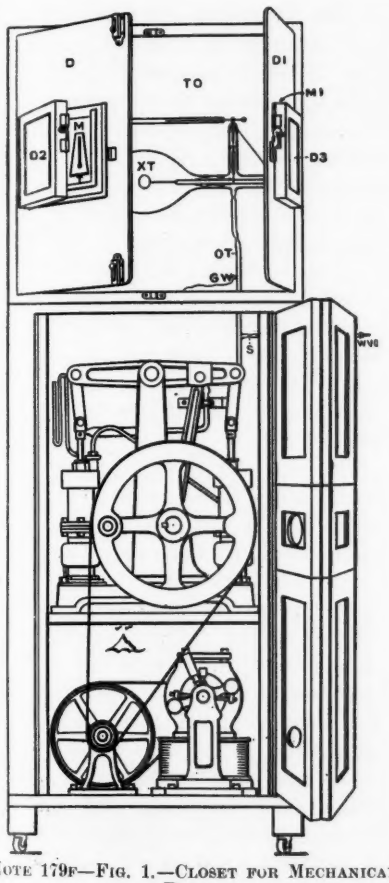
When it is desirable to immerse a patient in ether which is being rapidly polarized and depolarized by means of a varying electric current, it is customary in France to place him in a solenoid. If the arms or legs are to be treated, they are placed in smaller solenoids. When a limited area of the trunk, as a shoulder, is to be treated, an encircling solenoid is not suitable, for it is unwise to subject healthy tissues to therapeutic agents. In these cases it is best to use a principle new in therapeutics—that of limiting the disturbance in the ether by surrounding the wire, which may be in the form of a flat or extended spiral, either straight or flaring, with a metal surface, the metal shield having an opening toward the area to be treated. A number of such devices should be on hand to suit different cases. No figures are given, as the object of the note is to call attention to a principle which is of considerable value in therapeutics and not to illustrate special forms of apparatus.

In earlier notes the importance of limiting the direction of escape of X-light, derma rays and of the energy from the radio-active bodies has been insisted on, and this note is written to extend the principle to other agents used in electrotherapeutics.

NOTE CLXXIXF—ON AN ARRANGEMENT OF A MECHANICAL PUMP FOR EXHAUSTING VACUUM TUBES FOR USE IN MEDICINE.

In earlier notes the only pumps illustrated used mercury because they could

be made for a few dollars by experimenters. As mercury pumps may introduce mercury vapor[1] into vacuum tubes, where its presence is objectionable, an arrangement of a mechanical pump in connection with a cooling closet for the pump and hot closet for the tube is now illustrated, notwithstanding the great cost of the mechanical pump, as for low vacua the exhaustion is more rapid than with a mercury pump. The same precautions must be used to keep water vapor out of the pump when standing unused, as have been recommended in earlier papers in connection with mercury pumps.



NOTE 179F—FIG. 1.—CLOSET FOR MECHANICAL PUMP.

Therefore a glass tube should be attached to the mechanical pump by a ground joint instead of by a rubber tube, the ground joint being provided with a cup which when filled with oil will act as a seal. The other end of the tube should have a stopcock which must always be closed before the X-light tube is removed from the pump. Above the stopcock there should be a second similar ground joint for connecting the X-light tube. The same precautions recommended earlier for removing most of the air and water vapor from the vacuum tube by a hand pump before it is connected with the mechanical pump must be employed. The mechanical pump should be in a closet similar to those already shown in connection with mercury pumps, and illustrated in Fig. 1, provision being made for inserting ice to lower the temperature during hot weather to reduce the tendency of oil vapor to enter the vacuum tube. Oil vapor is less objectionable than mercury, for by raising the temperature of the tube oven it may be burnt out as directed in earlier notes, which should be consulted.

[1] In his experiments with radium bromide, Curie used two U-tubes cooled by liquid air to prevent mercury vapor from entering the tube. Whenever liquid air becomes available X-light tubes in which high vacua are needed should be exhausted with a mercury pump arranged in this way as no mechanical pump tested during these experiments will give a really high vacuum.

The Canadian Electrical Association.

The fourteenth annual convention of the Canadian Electrical Association was held at Hamilton, Ont., June 15, 16 and 17, 1904. The headquarters was at the Royal Hotel.

The following programme was announced:

WEDNESDAY, JUNE 15.

At 10.15 A. M., meeting of executive committee. At 10.45., welcome by mayor on behalf of the citizens of Hamilton. At 11.15 A. M., opening session to 12.45 P. M. At 2 P. M. to 5 P. M., papers on "The Origin and Development of Storage Batteries," by E. B. Walker; "Aluminum Wire as a Conductor," by Roderick J. Parke, followed by the question box. At 7.45 P. M. to 10 P. M., papers on "The Curtis Steam Turbine," by Frank C. Smallpiece, and "The Niagara Power Development," by K. L. Aitken, followed by the question box.

THURSDAY, JUNE 16.

At 9 A. M., cars to Victoria street substation; then to Deering works and Westinghouse works, returning to headquarters at 11.15 A. M. At 11.15 to 12.45 P. M., paper on "Alternating-Current *versus* Direct-Current Arc Systems," by W. L. McFarlane, followed by question box. At 2 P. M. to 6 P. M., papers on "Heavy Electric Traction by Alternating Currents," by P. M. Lincoln; "The Statistics of Canadian Progress in Electrical Applications," by George Johnson, Dominion statistician, followed by question box, election of officers and unfinished business. At 8.30 P. M., annual banquet.

FRIDAY, JUNE 17.

At 8 A. M., street cars to Grand Trunk Railroad station. At 8.30 A. M., Grand Trunk Railroad to St. Catherines; then conveyances to DeCew Falls. Luncheon in the power-house, 11.30 A. M. to 12.30 P. M. Conveyances to Grand Trunk Railroad and train at 1.21 P. M. to Niagara Falls, then International Traction Company to power works on Canadian side of river, returning to Grand Trunk Railroad station at 4.45 P. M.

High-Tension Transmission Meeting at Chicago.

A special meeting of the American Institute of Electrical Engineers will be held at Chicago, Ill., June 21 and 22, 1904. The meeting will be conducted by the transmission committee, assisted by the Chicago branch of the Institute. There will be a morning and an afternoon session each day, the work to be divided, as nearly as possible, equally among the four sessions. Introductions to discussions similar to those presented at the three meetings on high-tension transmission held at New York, will be presented.

The following programme has been announced:

TUESDAY, JUNE 21.

At 10 A. M., "Line Construction with Steel Supporting Structures and Long Spans," by F. O. Blackwell; "Protection of Cables from Arcs Due to Failure of Adjacent Cables," by W. G. Carlton. 12.30 P. M. to 2.30 P. M., recess for luncheon. 2.30 P. M., "The Use of Ground Shields in Transformers," by John S. Peck; "Conditions for Continuous Service over Lines Operated in Parallel," by M. H. Gerry, Jr.

WEDNESDAY, JUNE 22.

At 10 A. M., "Synchronous Motors for the Regulation of Power-Factor and Line Voltage," by B. G. Lamme; "Protection of High-Tension Lines Against Static Disturbances," by H. C. Wirt. 12.30 P. M. to 2.30 P. M., recess for luncheon. 2.30 P. M., report of the transmission committee on data collected; general discussion on topics presented at the meeting.

The electrical interests of Chicago have offered to provide entertainment for Wednesday evening, June 22.

The place of meeting will be at the offices of the Western Society of Engineers, Monadnock Building, Chicago, Ill.

The Michigan Technic.

The Michigan Technic, the annual publication of the Engineering Society of the University of Michigan, recently published, contains several interesting contributions. Short biographical sketches of the late Charles Ezra Greene, dean of the engineering college; of the present dean, M. E. Cooley, and of Joseph Baker Davis, professor of civil engineering, form instructive reading. Perhaps the article of most interest to the electrical engineer is one entitled "Switchboard and Panelboard Design and Construction," by Mr. Arthur Frantzen. This considers the requirements of any switchboard, and the proper way of meeting them. Mr. R. P.

Jackson contributes an article on the aluminum carbon cell used as a rectifying device. Among the other subjects discussed are: "Good Roads, Who Should Build Them," by J. N. Hatch; "Draughting-Room System," by G. A. Worden; "Locomotive Road Tests," by J. C. Thorpe; "Value of Gas Analyses and Gas Engine Tests," by A. H. White; "The Testing of Lubricating Oils," by F. S. Parmenter; and "Test of a Kerosene Engine," by W. A. Detwiter and L. N. Udell.

The International Electrical Congress.

Acceptances of membership in the International Electrical Congress, which is to be held at St. Louis, Mo., September 12 to 17, now number 1,702, and over 160 specially invited papers have been promised. One thousand certificates of membership have been issued, and about one hundred more are to be issued. Efforts are being made to secure the manuscripts of as many of the 160 papers as possible by July 1, in order to have them printed in advance and distributed among the congress members at St. Louis.

Programmes for sections A, B and C have already been published. The programmes scheduled for sections D and E are as follows:

SECTION D.

"Electrical Transmission Plants in Switzerland"—Signor E. Bignami.

"Conditions Conducive to Economy in Motor Design"—H. M. Hobart.

"Transmission of Alternating Currents Over Lines Possessing Capacity"—M. Maurice Leblanc.

"Utilization of Hydraulic Powers in Italy"—Professor G. Mengarini.

"High-Potential Long-Distance Transmission and Control"—Professor F. G. Baum.

"The Tower System of Line Construction"—F. O. Blackwell.

"The Use of Aluminum as an Electrical Conductor"—H. W. Buck.

"High-Tension Insulators"—V. G. Converse.

"Line Construction and Insulation for High Tensions"—M. H. Gerry, Jr.

"Bay Counties Transmission System"—L. M. Hancock.

"Some Practical Experiences in the Operation of Many Power-Houses in Parallel"—R. L. Haywood.

"Long-Distance Power Transmission"—J. F. Kelly and A. C. Bunker.

"Transmission and Distribution Problems Peculiar to the Single-Phase Railway System"—P. M. Lincoln.

"The Maximum Distance to Which Power Can Be Economically Transmitted"—R. D. Mershon.

"Pioneer Work of the Telluride Power Company"—P. N. Nunn.

"The High-Tension Transformer in Long-Distance Power Transmission"—J. S. Peck.

"American Practice in High Tension" (N. E. L. A. paper)—Dr. F. A. C. Perrine.

"Theory of Single-Phase Motors" (A. I. E. E. paper)—Dr. C. P. Steinmetz.

SECTION E.

"Impregnated Arc Light Carbons"—Professor André Blondel.

"Single-Phase Motors"—Herr Max Déri.

"Rates for Electricity Supply"—Herr E. de Fodor.

"Insulating Materials in High-Tension Cables"—Signor Ing. E. Jona.

"Upon a Means for Compensating the Series Connection of Induction Motors"—Professor W. Kübler.

"Storage Batteries"—Herr Karl Roderbourg.

"Commercial Limits of Electric Transmission with Special Reference to Lighting Service"—Signor Ing. Guido Semenza.

"The Superiority of the Alternating Current for Distribution in Large Cities"—Dr. G. Stern.

"Measurements of the Energy of Light and Heat Radiation from Electric Light Sources"—Dr. W. Wedding.

"Recent Improvements in Electrolytic Meters"—Arthur Wright.

Subject to be announced—Professor S. P. Thompson.

"The Testing of Alternating-Current Generators"—B. A. Behrend.

"Protection and Control of Large High-Tension Distribution Systems" (N. E. L. A. paper)—George Eastman.

"Rotary Converters and Motor-Generators in Connection with the Transformation of High-Tension Alternating-Current to Low-Tension Street Current" (Assn. Ed. Illg. Cos. paper)—W. C. L. Eglin.

"The Effect of Steam Turbines on Central Station Practice"—W. L. R. Emmet.

"Underground Electrical Construction" (Assn. Ed. Illg. Cos. paper)—Louis A. Ferguson.

"Storage Batteries as an Adjunct to Central Station Equipment" (Assn. Ed. Illg. Cos. paper)—Gerhard Goettling.

"American Meter Practice" (N. E. L. A. paper)—G. Ross Green.

"Metering Efficiency on Customers Premises"—Caryl D. Haskins.

"Steam Turbines"—Francis Hodgkinson.

"Incandescent Lamps"—John W. Howell.

"Distributing Systems from the Standpoint of Theory and Practice"—Philip Torchio.

"The Selection of a Distributing System for a Large City"—W. F. White.

The chairman of section D, which takes up power transmission, is Mr. Charles F. Scott, and the secretary, Dr. Louis Bell. The chairman of section E, which takes up electric light and distribution, is Mr. John W. Lieb, Jr., and the secretary, Mr. Gano S. Dunn.

An Electrical Oil Separator.

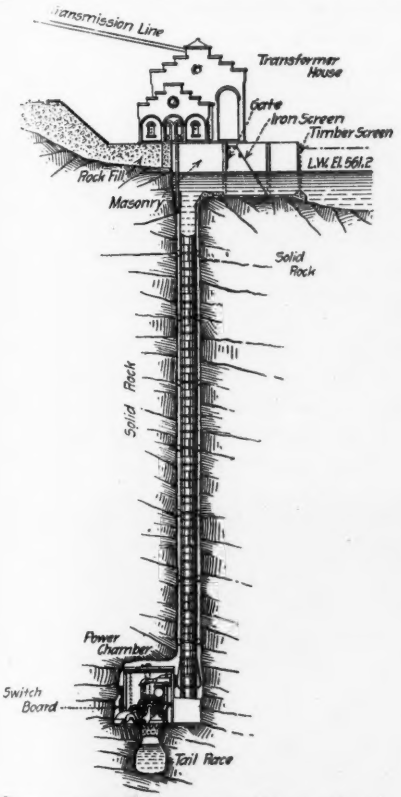
A great variety of methods has been tried to remove effectively oil from the air pump discharge of a condensing plant. The great difficulty is caused by the fact that the oil forms an emulsion with the water, and an ordinary filter will not be sufficient to separate the two; hence, chemical reagents are frequently employed. A new process, known as the Davis-Perrett electrical system of separation, has been tried at the Leicester (England) Corporation's power-house with reported success. The apparatus is described and illustrated in the *Electrician*, London, May 27.

The separator consists of two large wooden tanks, each divided into five compartments. In each compartment are ten plain sheet-iron plates about one-quarter of an inch thick. All of the compartments are connected in series across a 500-volt circuit. There are thus five plates in parallel. Grooves are cut in the partitions, dividing the compartments, and in the bottom of the tanks, the plates being inserted in these grooves so that the water must pass through the compartments, going under one plate and over the next. The Leicester plant is capable of handling 6,000 gallons of water per hour. It requires twelve amperes of 500 volts. It is said that the sheet-iron plates last from two to three years. After working for a certain length of time, they become coated with a deposit which is easily removable by causing the current to pass through the tanks in the opposite direction. The deposit rises to the surface and may be skimmed off. No other attention is necessary. The action of the current is to cause the emulsified oil to coalesce. When the liquid is passed subsequently through a mechanical filter, there is no difficulty whatever in catching the particles of oil and allowing the purified water to pass to the hot-well. The separator may be used with any type of filter.

Snoqualmie Falls and White River Power Transmission Plant in Washington.

By Frank C. Perkins.

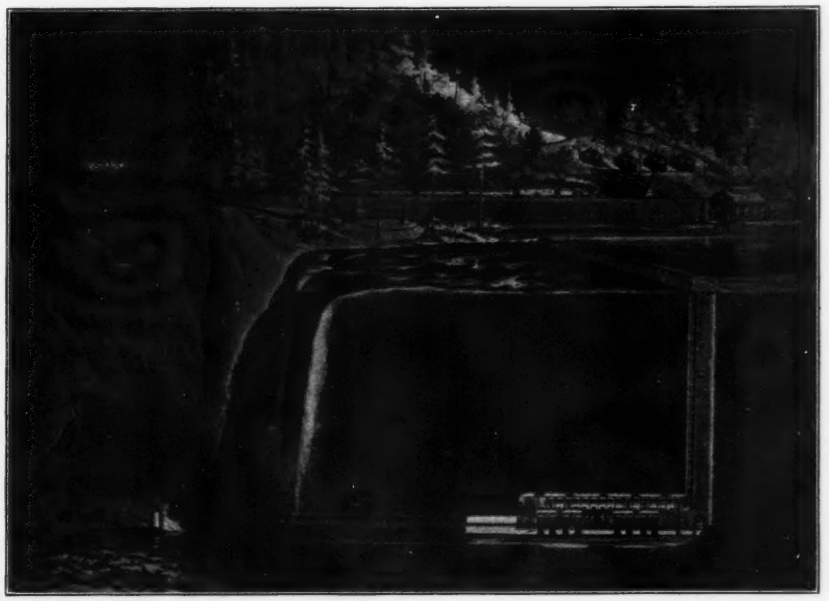
ONE of the most important hydro-electric power developments in America has recently been completed in the state of Washington, by the Snoqualmie Falls & White River Power Company. At the falls on the Snoqualmie river there is a vertical drop of 270 feet which gives an available capacity of 100,000 horse-power. The power plant has a present capacity of 10,000 horse-power and will be increased as necessity requires. The power company is constructing at the present time a plant of 50,000 horse-power capacity near Sumner on the White river. The first installation of the White river power plant will have an output of 10,000 horse-power, and the current will be transmitted to the same substations as from the Snoqualmie plant as well as to other substations exclusively supplied from this power-house. The radius of distribution about this plant already supplied with wood fuels and cheap coal is about 250 miles. Both the White river plant and the Snoqualmie Falls plant are located about 660 feet above the sea-level and they supply about one-third more power in winter than in summer, the demand for power from Seattle and Tacoma being greater and the supply of water also increasing during that season. The White river is a glacial stream having its source in the snow-capped peak of Mount Rainier. The power-house is constructed in the foot hills of the Cascade mountains, and the first 1,300 feet of the canal supplying this power-house are excavated along a side hill and lined with rubble stones with a width of twenty-five feet and a depth of ten feet. From this point the canal is lined with concrete and is partly open and partly tunneled, leading into four lakes varying in size from eight to sixty-eight acres, each acting as natural reservoirs and settling basins. The water is then conducted into the storage basin at Lake Dorthery. This lake provides a vast volume of water as a reserve for use in the electric power generating station. This great natural reservoir is located directly above the power plant and has a storage capacity of over five billion cubic feet, or an output of 50,000 horse-power for two months.



SECTION OF TRANSFORMER-HOUSE, SHAFT, POWER-HOUSE AND TUNNEL, SNOQUALMIE FALLS POWER DEVELOPMENT.

The power station in the White river valley near Sumner is over 200 feet in length and over 100 feet in width and is constructed of iron, brick and stone. Ten four-foot pipes conduct the water from the Lake Dorthery storage basin to the ten water-wheels in the power-house, each having a capacity of 5,000 horse-power. These water-wheels operate under a net fall of 485 feet and are directly coupled to Westinghouse alternators which supply current to various banks of three transformers each, located in fireproof compartments. These transformers are connected to the transmission line and electrical generators through switchboards and operating galleries located on the second floor of the power plant. Double break oil switches are employed, operated by electropneumatic control, the transformers being connected to the lines in the usual way.

The White river power plant and the Snoqualmie Falls power station will deliver current into the same transmission system with two independent circuits and two independent pole lines from each power station. The power transmission line consists of seven-strand aluminum cables mounted on porcelain insulators, the spacing being nine feet between the wires in each circuit. The power transmission will be extended to Bellingham on the north and Portland on the south.



PROFILE, SHOWING PLAN OF HYDRAULIC POWER DEVELOPMENT AT SNOQUALMIE FALLS.

The Snoqualmie Falls power company supplies current only in large quantities to manufacturing plants and to electric companies for railway, light and power distribution. These companies include the Tacoma Railway and Power Company and the Tacoma Cataract Company, of

Tacoma, Wash., a city of about 40,000 inhabitants, located about thirty-four miles from Snoqualmie Falls power plant and about twenty-five miles from Seattle. Current is also transmitted a distance of twenty-five miles from the same power plant to Seattle, a city of about 80,000 inhabitants, which utilizes about two-thirds of the power generated at the present time. The distribution of current for light and power in this city is made by the Seattle Electric Company and the Seattle Cataract Company. Another transmission line is soon to be installed from the Snoqualmie Falls plant to Everett, a city of about 10,000 inhabitants, located about thirty-five miles away, which has many factories and small industries requiring a considerable amount of power as well as a paper mill and smelter, which will ensure the utilization of about 2,000 horse-power.

The Snoqualmie falls is about 600 feet above the sea-level and is supplied by the Snoqualmie river, the watershed of which reaches elevations of between 8,000 and 9,000 feet above the sea-level and having an area of about 500 square miles. The intake bay lies parallel with the river and is of rectangular shape, measuring twenty feet wide and sixty feet long and supplies water to the underground power chamber and tail-race tunnel below. A pier separates the two head bases of the intake, the capacity being twice that of the present power development. A water rheostat, having a capacity of 2,500 horse-power, is now located in the idle head-bay and is connected with the switchboard in the underground power chamber for use in an emergency should the normal load be suddenly thrown off.

A shaft of rectangular section, twenty-seven feet long and ten feet wide, was sunk in the river bed at a distance of about 300 feet above the Snoqualmie falls. This shaft reaches a depth of 270 feet or the level of the river below the falls and connects with a tunnel twenty-four feet high and twelve feet wide having a fall of two feet, this tunnel being utilized as a tail-race. The underground power station begins at the bottom of the shaft and is thirty feet high and forty feet wide, extending along the tunnel a distance of about 200 feet. The electrical generators and the water-wheels are located in this underground power-house, the tunnel extending under the floor of the chamber which has a concrete floor forming the roof of the tunnel with a thickness of five feet. The tunnel and the shaft, together with the underground power station, are lighted by several hundred incandescent lamps, while the natural draught through the tail-race and up the shaft provides all the ventilation which is required. It is stated that the temperature is practically the same throughout the year, being about fifty-five degrees Fahrenheit, while the generator room is said to be perfectly dry.

ALTERNATORS, WATER-WHEELS AND PENSTOCKS, SNOQUALMIE FALLS POWER PLANT.

The centre compartment of the vertical shaft is ten feet long and eight feet wide, and is provided with an hydraulic elevator, while in the other two compartments are installed the penstocks. The elevator as well as the electrical cables conducting the current to the surface are enclosed in a steel bulkhead which extends from the surface of the ground to the bottom of the intake bay. The first penstock constructed has a diameter of seven feet six inches, and is built of plates one inch thick at the bottom, decreasing in thickness to one-half inch at the top. The penstock connects with a horizontal cylindrical receiver at a depth of 250 feet, this receiver resting on a rock bench at one side of the chamber at a height of twelve feet above the floor and extends nearly the whole length of the chamber. This horizontal cylinder is eight feet in diameter at the end furthest from the shaft, and ten feet in diameter at the point of junction with the penstock, the two weighing about 450,000 pounds, while the weight of water is about 680,000 pounds.

The receiver is constructed of plates eight feet wide and one inch thick, and is provided with four branches, each having a diameter of forty-eight inches and each is fitted with a special gate-valve weighing nearly twelve tons each. A cast-iron elbow, turning downward, is provided at each branch, opening into a separate horizontal cylindrical receiver provided for each water-wheel.

Each of the four water-wheels has a capacity of 2,500 horse-power and is direct-coupled to a Westinghouse three-phase alternator having an output of 1,500 kilowatts. The water motors are of the Doble type with six tangential jet wheels mounted on the same shaft, each having two nozzles. Each of the twelve jets has a diameter of three and seven-eighths inches. Two long rocker shafts are provided for operating the regulating nozzles, one for controlling the lower nozzle tip and the other the upper nozzle tip, a Lombard governor being connected to the rocker shaft by cranks and connections, the latter being so arranged that either or both rocker shafts may be disconnected from the governor. In this case the regulation would be maintained by the hand-wheel on the pedestal stand. These water-wheels by being governed with the regulating nozzle tips utilize

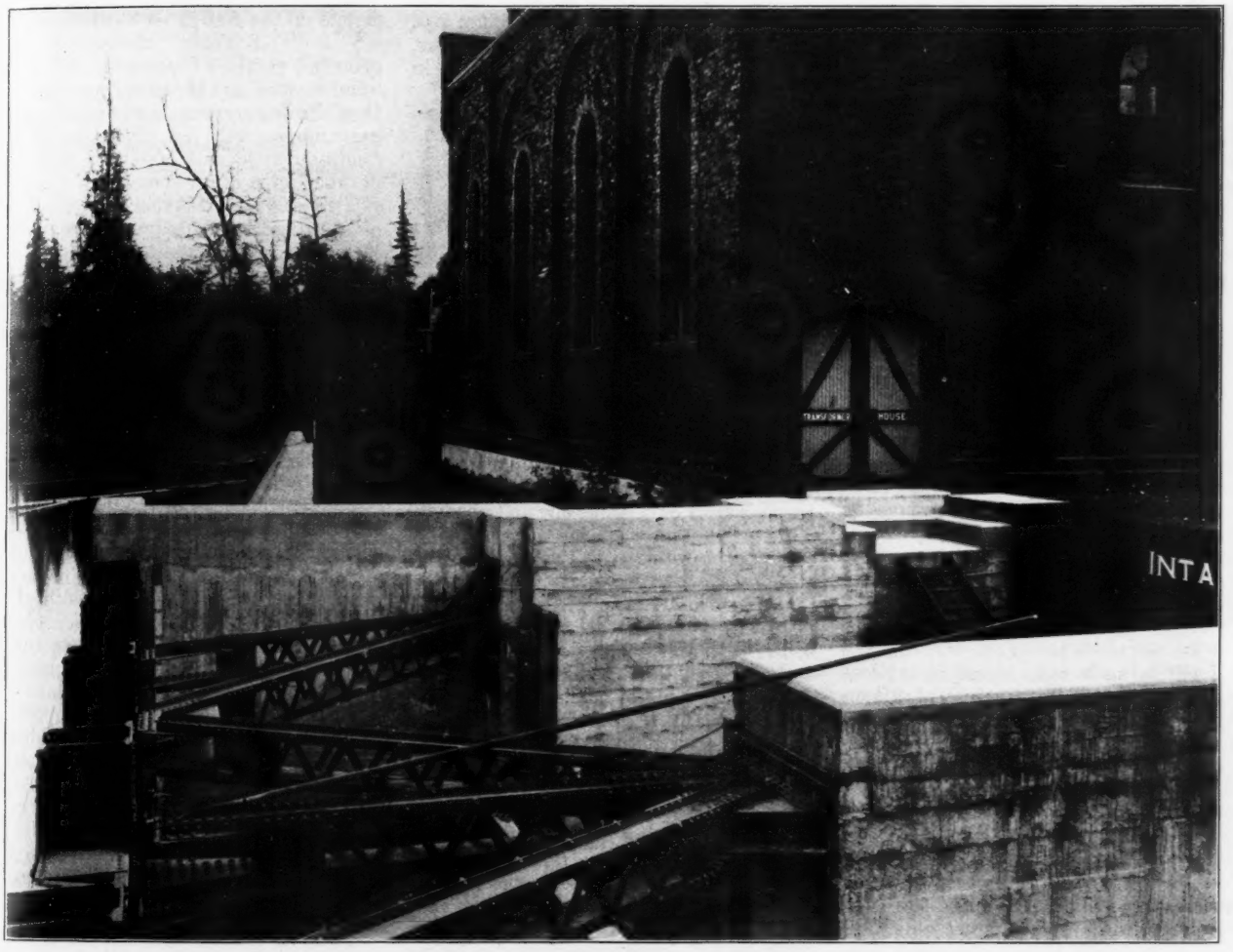
EXTERIOR OF TACOMA SUBSTATION AT NIGHT, SNOQUALMIE FALLS POWER DEVELOPMENT.

water only in proportion to the power developed, resulting in a very high efficiency at part load, which is very desirable.

The Westinghouse three-phase generators are each about fifteen feet high, weighing about fifty tons. They are of the revolving armature type having a speed of 300 revolutions per minute. The full-load current is normally about 1,000 amperes per phase, the frequency being 7,200 alternations per minute and the pressure 1,000 volts. The armatures weigh about twelve tons each and are eight feet in diameter with a closed circuit winding, one bar being utilized in each of the 266 slots. The collector rings delivering current to the external circuits are of the ventilating type, with three brushes bearing on each ring. The field magnet frame is mounted on the bed-plate which supports the armature bearings and is split vertically so that the two halves may be moved apart laterally when desired.

These alternators require a field current of ninety-five amperes with a pressure of ninety volts at no load and 100 amperes at full load.

The exciting current is supplied by two seventy-five-kilowatt machines of 125 volts pressure, direct-coupled to 100-horse-power Doble wheels. These water motors have ten tangential ellipsoidal water-wheels, each forty-five inches in diameter mounted in steel housings. These water-wheels are supplied through a regulating nozzle of three-inch diameter from a vertical pipe twelve inches in diameter. As the load is very steady on the exciter dynamos the regulation is effected entirely by hand, the automatic speed regulators being omitted.



STEP-UP TRANSFORMER HOUSE AND INTAKE, SNOQUALMIE FALLS POWER PLANT.

A fireproof building constructed of iron and brick with a concrete floor is located at the head of the shaft and utilized as a transformer house. It is sixty feet long and forty feet wide with a height of thirty feet and is equipped with Westinghouse step-up transformers. These transformers receive the current from the switchboard in the generator station at a pressure of 1,000 volts through aluminum cables, and raise the pressure to 30,000 volts, which is the voltage used on the long-distance power transmission line.

There are thirteen transformers in the building above mentioned, each having a capacity of 500 kilowatts. The transformers are arranged in two rows, delta connections being employed for both primary and secondary circuits, each of the transformers weighs about five tons, 500 gallons of oil being utilized in each case for cooling purposes. These transformers are mounted in cases sixty-six inches high, which occupy a floor space of seventy-two inches by fifty-five inches. The circuits consist of stranded aluminum cables with a conductivity sixty per cent of that of copper, therefore having a cross-section that much greater, but weighing only about one-half as much. It is possible, therefore, to make the spans of the transmission line longer, with a saving in the number of insulators and poles required. The length of span varies from 90 to 150 feet and a sag of fifteen inches is allowed, which is much greater than usual with copper conductors. Separate pole lines are provided for Seattle and Tacoma, and these are parallel for a distance of nearly twenty miles, diverging at Benton. About thirty-four tons of wire are employed in the Seattle transmission line and about thirty-six tons on the Tacoma line, the distances being thirty-one miles and forty-

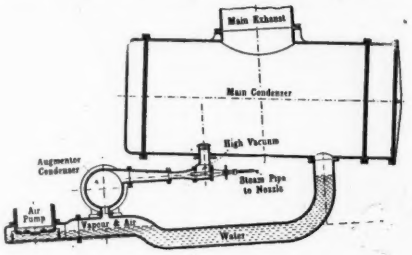
four miles, respectively. Small substations have been installed at Issaqua and at Benton, located ten miles and nineteen miles, respectively, from the power plant. The Tacoma substation is equipped with transformers having a total capacity of 2,100 kilowatts. Three of the transformers in this substation have a capacity of 500 kilowatts each, while two units have each an output of 200 kilowatts.

The Seattle substation is provided with three step-down static transformers for supplying current to rotary converters at a pressure of 350 volts. The two rotary converters each have an output of 500 kilowatts, supplying a continuous current at 550 volts. These machines are of the eighteen-pole type, having a speed of 400 revolutions per minute. A small induction motor is mounted on the armature shaft in each case to bring the rotary into synchronism.

In addition to the above machines there are four pairs of step-down transformers of 300 kilowatts capacity and two pairs each having an output of 500 kilowatts. These machines have 2,000-volt secondaries and are connected so as to change the current from a two-phase to a three-phase for general lighting and power distribution. The total output of this substation is, therefore, nearly 4,000 kilowatts. Taking the energy of the water at Snoqualmie falls at one hundred per cent, the percentage available at full load with a loss of ten per cent on the line is fifty-seven per cent at the rotary transformers, sixty-three per cent from the step-down transformers and sixty-five per cent to the step-down transformers. The percentage of power available from the step-up transformers at the power station is seventy-two per cent, from the generator seventy-five per cent, and from the water-wheels eighty per cent, and it is stated that an increase in the amount of wire on the line will be made so as to reduce the loss to ten per cent. With a loss of fifteen per cent on the line, the energy from the water-wheel is eighty per cent, from the generator seventy-five per cent, and from the step-up transformers seventy-two per cent. The energy available from the rotary transformers is fifty-three per cent, from the step-down transformers fifty-nine per cent, and to the step-down transformers sixty-one per cent. As mentioned above, two-thirds of the power developed at the Snoqualmie Falls power plant is at present utilized in the city of Seattle, the total being about 10,000 horse-power, while eventually several times this amount will be employed for industrial purposes in the various cities and towns surrounding this important power development.

The Parsons Vacuum Augmenter.

In a recent paper before the British Institution of Electrical Engineers, on "The Steam Turbine as Applied to Electrical Engineering," by Messrs. Charles A. Parsons, C. G. Stoney and C. P. Martin, the Parsons vacuum augmenter was described. This is a device for extracting the air from the condenser, and, it is said, has produced a great improvement in the vacuum. When applied to a condenser, the air pumps are placed about three feet below the bottom of the condenser, as illustrated in the figure. From any convenient part of the condenser—preferably near the bottom—a pipe is led to an auxiliary condenser, generally with about one-twentieth of the cooling surface of the main condenser, and in a contracted portion of this pipe a small steam jet is placed, which acts in the same way as a steam exhauster or the jet in the funnel of a locomotive. It sucks nearly all the residual air and vapor from the condenser, and delivers it to the air pumps. A water seal is provided to prevent the air and vapor returning to the condenser. Thus, if there is a vacuum of 27.5 to 28 inches in the condensers, there may be only about twenty-six in



THE PARSONS VACUUM AUGMENTER.

the air pump, which, therefore, need only be of small size, the jet compressing the air and vapor from the condenser to about half or a little less of the original volume. The small quantity of steam from this jet—which is only about one and one-half per cent of that used by the turbine at full load—together with the air extracted, is cooled down and condensed by the auxiliary condenser, which is generally supplied with water parallel to the main condenser. In this connection, it should be observed that condensation in the condenser takes place much more rapidly and effectually if the air is thoroughly extracted, than if there is much air present, as the air seems to form a blanket around the tubes, and retards the steam from getting to them. Tables and curves were given, showing the difference of consumption and without this augmenter. These indicate an increase in the vacuum of one inch at no load, and of two inches with a load of 1,200 kilowatts. At the latter load the augmenter showed a saving of about two pounds of water per kilowatt-hour.

Electric Locomotives.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

The very neat picture of the electric locomotives designed for the New York Central & Hudson River Railroad, and description of same, which you published in issue of June 4, 1904, are very creditable in many respects as showing the latest method of adapting electric power to the heavy service required for such traction purposes as these locomotives will be called upon to perform.

Considering, however, the talent employed and commanded by the New York Central & Hudson River Railroad Company, I am greatly surprised to note that these competent engineers have decided to place the armatures of the motors directly on the axles, thus going back to some of the first experiments made years ago by the late Professor Sidney H. Short, and which was abandoned by him on account of many practical difficulties which he found could not be overcome, and which, therefore, led him to mount the armature on a sleeve surrounding the axle, allowing clearance for vibration, inequalities of roadbed, etc.

The difficulty experienced by Professor Short with his comparatively small motors will be largely increased in the far heavier motors on the New York Central & Hudson River Railroad locomotives. The principal trouble, I prophesy, will be in commutators and brushes, and judging from Professor Short's experience, these commutators will not retain the perfect condition they must absolutely adhere to in order to be at all operative, for a week at a time, when in actual service.

Granting that many improvements have been made in commutator design and construction during the past fifteen years, and at the present time it is possible to manufacture large direct-current commutators for 500 or 600 volts, or even a higher voltage, which are eminently satisfactory for stationary work, this does not prove that the same construction will be at all satisfactory when operated under the severe conditions which these locomotives will be subjected to.

The irregularities of the track, switches and frogs, crossings, curves at high speed, will all have a tendency to jar loose commutator bars, and a variation or movement of one bar one-one-hundredth of an inch beyond the wearing surface of the brushes, will be sufficient cause to injure a commutator so that it will require returning. With the armatures mounted rigidly on the axles, it will be impossible to return commutators in place, unless a special revolving tool has been or can be designed for such emergency repairs. To jack up the locomotive, remove the axle, wheels and armatures, put the whole apparatus in a lathe, return and replace in position again, will be an endless expense which I predict will be the eventual result of this type of locomotive.

No doubt the engineers have given these matters due consideration and are willing to take their chances on the service being satisfactory, but the railroad company will have "to pay the piper" in the end.

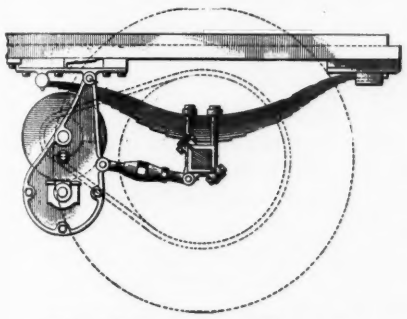
This construction will never be satisfactory and will cause no end of trouble and annoyance. It will be a great regret to all parties if such an electrical engineering undertaking of the magnitude now under construction by the New York Central & Hudson River Railroad to handle its enormous traffic in the vicinity of New York city should depend upon its successful operation in the construction, design and mounting of the armatures rigidly on the axles of the locomotives.

FREDK. A. SCHEFFLER.

Harrison, N. J., June 10.

Electrical Patents.

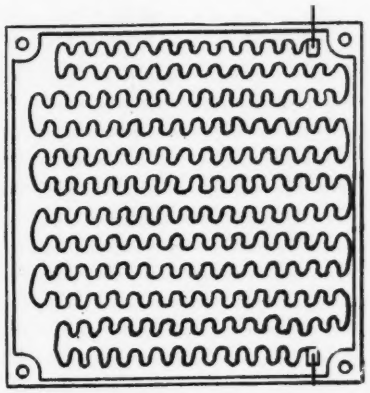
A motor suspension for vehicles is the subject of a patent granted to Mr. Hiram P. Maxim, of Pittsburg, Pa. The object of the invention is to so improve motor suspension for vehicles that the construction thereof is greatly cheapened and simplified, and to so suspend the motor that all driving strains will be self-contained between the motor and driving-wheel axle and will not affect or be affected by the vehicle springs. In the embodiment of the invention the motor is enclosed in the usual casing, and both the casing and motor is suspended from the body of the vehicle by a simple hinge joint. One member of this joint is formed on the motor-casing or arm and the other is bolted to the vehicle body. There are two suspending-arms, one at each side of the motor, and the hinge is preferably a double-jawed one; that is, one member has two jaws, so that the severe jolts to which vehicles are subjected will not bring



Motor Suspension for Vehicles.

all the lateral strain on one of the motor-arms. The plane of the wheels is slightly inclined from a true vertical position, and this causes the driving-sprockets on the wheels to be also slightly inclined. It is desirable to incline the sprocket on the motor so that it will align with the sprocket on the wheel, and this can be done by mounting the motors so that their outer ends are slightly lower than their inner ends. The motor is maintained at approximately uniform distance at all times from the vehicle axle by any suitable means. Gearing of the sprocket-and-chain type is arranged between the motor and the driving-wheel.

Mr. Charles E. Carpenter, of New York, N. Y., has assigned to the Cutler Hammer Manufacturing Company, of Wisconsin, a patent recently obtained by him on a method of making electrical heating apparatus. The invention consists, first, in the method of making such apparatus by placing a suitable resistance or conductor on vitreous insulating material, heating the insulating material, and pressing it while hot between the plates to be heated in the heating apparatus, so as to form an intimate contact between the insulating material and the plates. It



Methods of Making Electrical Heating Apparatus.

also consists in the method of making such apparatus by placing a suitable resistance between two layers of vitreous insulating material, then placing the layers of insulating material with the resistance between them between the plates of the heating apparatus, then heating the layers of insulating material or the entire device so as to fuse these layers and pressing the layers while heated or while in molten condition between the plates and around the resistance, so as to unite the layers and make intimate contact between all parts. It is preferable to use a layer of cold glass as the insulating material. Another feature of the invention consists in allowing the parts already mentioned to cool while securely fastened together and forcing the plates closer together, from time to time, as the insulating material cools and contracts. The insulating material is made of a thin layer of vitreous material, and in making it the resistance is encased and protected and at the same time insulated from the plate, the insulating material being pressed between the plates while in a molten or hot state, so that it entirely fills the space between the plates and is cooled in position in contact with these plates. The plates are so shaped as to be adapted to form a mould in which or between the parts of which the insulating material is pressed into shape, the insulating material being cooled in the mould under pressure and having as a result of this an intimate mechanical contact with the conductor or resistance as well as with the plates, and being held firmly in place against distortion or breakage.

Mr. Ignacy Moscicki, of Fribourg, Switzerland, has recently patented in this country an invention relating to high-tension electric condensers. Under otherwise similar conditions the capacity of the condensers is inversely proportional to the thickness of the dielectric which separates the two coatings. In consequence of this, the coatings must be as small as possible. On the other hand, however, the electrical pressure exercised on any part of the dielectric is proportional to the square of the electric pressure on the particular place in the coatings. If this pressure be increased anywhere beyond a maximum, determined by the strength of the dielectric, the dielectric is broken at the particular spot, being penetrated by an electric spark. In order to avoid this, it has been necessary hitherto in the case of high-tension condensers to make use of dielectrics with relatively stout sides. It has been proved that in the condensers employed hitherto, so far as the strength of the dielectric was not considerably impaired at any other spot by faults in the making, small cracks, or the like, the spot

High-Tension Electrical Condenser.

where a breakage occurred was usually found to be on the edge of a coating. The explanation of this is that the electric density at the edges of the coatings, and thus also the electric pressure, is greatest in these places. The improvement in high-tension condensers, which forms the object of the present invention, consists in the parts of the dielectric which support the edges of the coatings being considerably thicker than the remaining parts covered by the coatings. In carrying out the invention, the tubular dielectric is much thicker at the top than at the middle. The bottom is closed and pointed and is considerably thicker than the middle. The dielectric consists of a material, such as glass, with a high electrical constant. The outer coating does not extend to the top of the dielectric, while the inner coating entirely covers the interior surface. In the present embodiment, the thickenings are of the same material as the tube. They may, however, consist of some other material in the form of layers, it only being necessary that this material must have an equal, a higher or slightly lower dielectric constant if it is to act similarly.

Reviews of Current Engineering and Scientific Literature.

Experience with High-Tension Transmission Lines.

Some interesting experiences with high-tension lines are described briefly in this article by Mr. H. C. Reagan. He has found that, with 26,000 volts on a fifty-mile line, but little trouble was caused by a dense fog followed by rain and freezing temperature, although the insulators became coated with ice and sleet, dry ice evidently being a good insulator. In another case, a fire occurring beneath a high-tension line cracked off the petticoats of all three insulators, but did not stop the service. Upon one occasion an insulator pin on a 26,000-volt system broke, and the insulator fell off the wire, allowing the latter to remain upon the cross-arm. This condition lasted for five days, without causing any trouble, due, no doubt, to dry weather then prevailing. Upon another occasion, where a pin broke, the insulator remained upon the wire but fell over so as to allow the tie wire to touch the cross-arm. This burned a groove through the arm, across which the insulator bridged, and the line was operated for a short time in this condition. One of the most troublesome faults to locate was a puncture through the top of an insulator beneath a wire. This puncture reached through the porcelain and sulphur to the iron pin, and was only discovered by feeling all of the pins to detect that which was hot. Mr. Reagan has also had some experience with poorly annealed insulators. Many of these broke, making it necessary to replace all of those on a fifty-mile line.—*Abstracted from the Street Railway Review (Chicago), May 20.*

A New Receiver for Wireless Telegraphy.

The following receiver for wireless telegraphy, due to M. Pelcher, consists of an adaptation of the capillary electrometer. As is well known, the surface tension at the surface of contact between mercury and acidulated water is affected by the passage of an electric current from the one to the other. This action may be made to cause the mercury to shift its position in the tube, and in this way close a local circuit. The apparatus consists simply of a capillary tube partially filled with mercury, having the part above the mercury filled with acidulated water, and having its lower end dipping into a similar solution. The antenna is connected to a wire leading into the upper part of this tube, and connection is made to the ground from the vessel by means of a wire, good conductivity being secured by a layer of mercury on the bottom of this vessel. Two wires from a local signaling circuit are led into the capillary tube, one being below and the other just above the normal position of the upper surface of the mercury. When electric waves encounter the antenna, the changes in potential set up at the surface of the mercury cause the latter to rise and close the local circuit, thus giving the signal. A variation of this device consists of two capillary tubes, both sealed into a glass vessel which is partially filled with acidulated water, and covered with a flexible diaphragm. The diaphragm is then covered by a second vessel, from which two rubber tubes are led off. The oscillations of the mercury, due to electric waves, are thus communicated to the diaphragm, and the latter converts them into audible signals which can be heard by applying the tubes to the ear.—*Translated and abstracted from L'Éclairage Electrique (Paris), May 14.*

Electric Traction for Railways.

In this section of a serial on electric traction for railways, Mr. W. M. Mordey gives some details of the electric locomotive tested recently on an experimental line adjoining the works of the Maschinenfabrik Oerlikon, near Zurich. This locomotive is equipped with the Ward Leonard system, and is much simpler than might be imagined from the description. The author thinks it is hardly more complicated than an ordinary direct-current locomotive, and less complicated than the three-phase locomotive used on the Valtellina line. The impression of simplicity is due to the absence of resistances, controllers and connections, which in an ordinary locomotive take up a good deal of space. The locomotive weighs forty-one and one-quarter tons. It is rated at 400 horse-power, and its normal tractive effort is 3,000 kilogrammes, the maximum being 6,000. Its full speed is twenty-two and one-half to twenty-five miles an hour. The locomotive has four axles, and these are driven in pairs by two 220-horse-power direct-current motors. The motors are geared to a central axle, which drives the wheels by means of an outside connecting rod. A 400-horse-power motor-generator is mounted in the middle of the locomotive, the shaft pointing fore and aft. This runs at 1,000 revolutions per minute, and consists of a squirrel-cage non-synchronous single-phase motor directly coupled to an ordinary direct-current generator, the latter being capable of giving 600 amperes at 600 to 700 volts. The two rotating parts of this machine are placed on the same shaft between two outside bearings. The stator of the induction motor is wound to receive current at either 700 or 15,000 volts, fifty cycles per second. The direct-current generator is excited by a small dynamo driven by a small single-phase induction motor. This is fed with current at 700 volts by means of a small transformer. It is also used to start the motor-generator, so as to avoid drawing inductive currents from the line. A third induction motor drives an air pump for the air brakes. The braking, however, is done electrically by varying the excitation of the generator. During the tests the locomotive was attached to a heavy blocked car, and an attempt to start was made. Although the train motors took more than 700 amperes, the current drawn from the line was only about thirteen amperes. The locomotive was then exerting more than its full tractive effort, while taking from the line only about thirty-eight per cent of the full-load current. In the opinion of the author, these tests show that the Ward Leonard system is a practical and convenient method of single-phase alternating-current railway traction. Although it is obviously less simple than the direct use of large torque motors, it has features of interest and practical improvement which may very likely lead to its being preferred to the simpler methods for some kinds of work, especially for short lines with many stops. One advantage of the system is that it can work at ordinary frequencies, such as are suitable for electric lighting. —*Abstracted from the Electrical Magazine (London), May 26.*

Electric Power Distribution in England.

The extent to which the British electrical industries have suffered by the ill-advised legislation of 1882 is discussed by Mr. L. Hill, general manager of the South Wales Electric Power Distribution Company. The claim is made that, at that time, the English machinery was the best in the world, and that the

lead then held would never have been lost if parliament, in its short-sighted effort to make good bargains for the municipalities, had not put an abrupt end to most electrical enterprises by this disastrous act. The same spirit still prevails in England, and every effort to supply cheap power to manufacturing towns meets with the most violent opposition from foolish corporations. Lighting stations can not compete in the supply of power with power stations. This fact is recognized, as the latter are permitted to charge less than half the legal charge of lighting plants. A lighting plant is required by law to keep its pressure of supply constant within a range of four per cent above or below the normal, thus making it impracticable to run large intermittently worked motors off the lighting mains. Power stations are not hampered by the necessity of maintaining a very steady pressure, and can get along with a much smaller capital expenditure per unit sold. For power distribution a low frequency may be used. This leads to more mechanical machinery in the generating station, and the generators are easier to operate in parallel. Mr. Hill says that a colliery taking a maximum of 4,000 horse-power will find it cheaper to secure its supply of current from a power station than to erect its own generating machinery. In the latter case it will have to install a plant capable of dealing with a maximum demand, and about fifty per cent would be needed for reserve. A power company supplying ten collieries will require only a plant capable of generating some two-thirds of the aggregate of the maximum demands from each, and a reserve of ten per cent will be sufficient. Mr. Hill points out that, even for the work of hoisting, collieries will find an advantage in electric motors. The capacity of the latter for taking a momentary overload of 100 per cent renders it possible to adopt machinery of only about half the nominal power necessary for a steam engine to do the same work.—*Abstracted from Engineering (London), May 27.*

Overhead Tramway Construction.

In this article "Lineman" deals with the design, selection, arrangement and erection of overhead line material. He discusses standard practices in England, and points out the leading features of the best design. Iron poles, made of three lengths of lap-welded iron, are satisfactory, provided the joints are sound. The method of testing by dropping the pole is not recommended, as it is too severe. A pole should be tested by supporting it in a horizontal position, and loading it at the top. This test proves the value of the joint better than any other, as, in the event of a fault, the whole bend will take place at that point. Poles of small diameter are undesirable, since they give an appearance of weakness. The thickness of the metal should never be less than one-quarter inch. In placing the poles, great care should be taken to get the minimum strain upon them. Rust on the inside should be prevented by a coating of tar. If ornamental collars are used to conceal the joints, these must be painted inside as well as out, and the pole beneath the collar must also be painted. This will prevent the pole below being streaked with rust. The standard bracket-arm construction is described, a loose clamping to the pole being advised. For span wires and guard wires, ordinary commercial wire is satisfactory, but it is not advisable to require unusual tensile strength, since such wires are brittle and springy. Line insulators and their supporting castings should be designed for a maximum strength with a minimum amount of metal. Insulating material should be hard, but not brittle nor scaly, and should have a smooth, glossy surface. It should be capable of sustaining heavy pressures without change of shape, should be impervious to rain-water and free from any weathering effect, and should remain hard at temperatures up to 250 degrees centigrade. The last requirement is important, since many insulators have broken down, due to the heat generated by surface leakage currents. Straight line hangers should not have petticoats, since this prevents the very necessary washing which a good rain-storm provides, and does not keep the insulator dry, every passing trolley wheel throwing up sufficient water to make the whole thing wet. The metal of the ears should be tested for brittleness and to develop any hot cracks by bending. The practice of knocking off an excess of solder by a sharp blow should not be allowed. This is liable to start cracks. The requirements for line switches and their mountings are given. The use of fuses and circuit-breakers in boxes is thought to be unsatisfactory. The author concludes by urging the necessity of a thorough inspection of all material. He lays stress upon the fact that there is a minimum price at which good material can be supplied and erected.—*Abstracted from the Electrical Review (London), May 27.*

Reduction of Fire Hazards in Electric Plants.

In this article Mr. Howard S. Knowlton discusses ways and means of preventing fires in electric plants. It is of literally tremendous importance that the life of the most insignificant fire should be measured in seconds, and still more imperative is it that, as far as human knowledge can ensure, there shall be no combination of materials and circumstances capable of causing any fire whatever. The solution of the problem is a matter of details. The desirable construction of the power-house is taken up somewhat briefly, the use of fire shutters and wired glass being urged wherever windows or skylights are exposed to the danger of flame. It is particularly important to see to it that there is no weak point where a fire may start on the roof—a part of the building which is too frequently neglected. In regions traversed by high-potential transmission circuits, the risk to telephone and telegraph offices and other electric plants should be investigated by a skilled engineer. The cross of a high-tension wire and a low-tension wire is particularly dangerous, since it may start fires at widely scattered points. A table is given of the causes of fire in electric plants, an examination of which leads to the conclusion that the greater proportion are preventable. Careless operation is at the bottom of most of the trouble, and unceasing vigilance and inspection are the price of security. In fact, the whole problem of fire prevention is largely one of keeping all possible hazards in mind and watching all the dark nooks and corners. The supply and maintenance of apparatus for the discovery and extinguishment of incipient fires deserve the closest attention. Within an electric plant water is of no value in putting out an electric fire; hence, automatic sprinklers are undesirable. Extinguishers of the dry-powder, chemical or compressed-gas type will be far more effective for all-around service. While a daily examination of all fire apparatus is not necessary, it is unwise to let more than a week elapse between inspections. It pays to file written reports discussing changes in the fire-fighting equipment of the plant, and usual conditions, refilling of pails, etc. The responsibility for this work should be laid upon one employé alone, and his reports should receive the attention of the superintendent, and not be allowed to lapse into mere perfunctory records. It is important that all electric stations should be provided with alternative sources of illumination, since a fire will often put out the electric lights. Automatic fire-alarms are necessary in all plants which are divided into several rooms. Money spent for thermostats is well invested. Arrangement of the machinery should be carefully studied, plenty of clear space being left overhead, so that the crane may remove quickly and safely any damaged piece of apparatus. A few hundred dollars will go a long way toward completely protecting all but the largest plants from all fires, except those which are humanly speaking, unpreventable.—*Abstracted from the Engineering Magazine (New York), June.*

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Solenoids and Electromagnets.

The Electric Controller and Supply Company, Cleveland, Ohio, is the manufacturer of a line of electromagnetic apparatus, embodying special features, which has been operated for some time with more than ordinary success. The accompanying illustrations show a few of the applications of these electromagnetic devices to commercial apparatus. With ordinary forms of electromagnets of the horseshoe and single-plunger ironclad types, there is an undesirable characteristic in the increase in pull as the plunger approaches the stationary pole or plug, causing a rapid acceleration toward the end of the stroke. When the motion of the moving part is arrested through the plunger striking the stationary pole or other stop, a blow involving a considerable amount of energy is delivered, and the frequent repetition of this causes wear and tear and the loosening of bolts and other parts. In order to overcome these objections, the Electric Controller and Supply Company has designed a new form

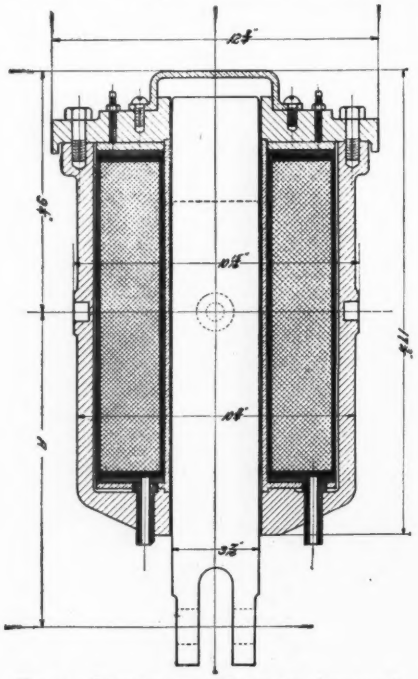


FIG. 1.—SECTION OF "MAGNETIC CUSHION" SOLENOID.

of electromagnet termed the "magnetic cushion" type. Fig. 1 is a sectional drawing, and Fig. 2 a reproduction of a photograph illustrating the construction of this type of electromagnet. The initial pull of the magnet through the air-gaps is equal to that of a plugged or stopped type of magnet of equal weight, and a desirable characteristic is obtained, in that the curve of tractive force is almost horizontal, obviating rapid acceleration of the plunger toward the end of the stroke.

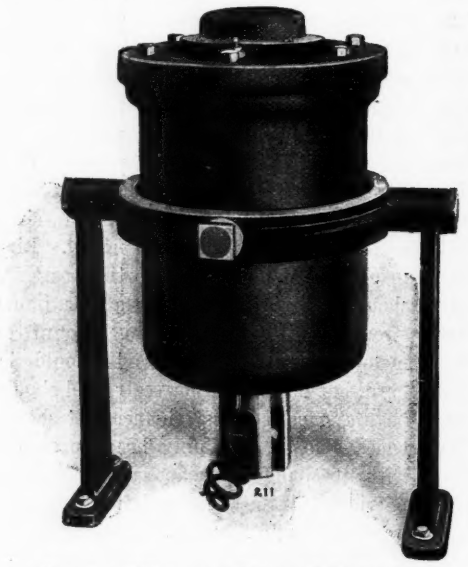


FIG. 2.—"MAGNETIC CUSHION" SOLENOID.

The motion of the plunger is arrested by the action of the magnetic field, which gives rise to the designation, "magnetic cushion." No mechanical stop is provided, and there is no blow or shock when the plunger is brought to rest at the end of its travel. For operation in exposed places, the winding of the magnet is completely enclosed and protected by the ironclad construction of the return magnetic circuit.

The method of supporting the magnet is also novel. The outer casing is hung in the plane of its centre of gravity on two trunnion pins carried in a supporting ring, which, in turn, is supported pivotally by a pair of trunnions mounted in stationary bearings. This construction eliminates the necessity of links or slotted holes in the connection of the plunger, and the operating lever of the mechanism to which it is attached prevents the plunger from binding in the bore of the magnet, and allows the magnet to adjust itself to inequality or poor alignment in the setting.

Fig. 3 illustrates three older types of electromagnets, the designs of which have been superseded by the magnetic cushion type. These, however, serve to illustrate the variety of requirements which the company is able to meet in its standard line of manufacture. The smallest magnet of the three is of the horseshoe plugged type, capable of lifting 175 pounds through two inches, when used in series with a fifty-horsepower 220-volt motor. The second magnet is of the ironclad plugged type, shunt-wound for 220 volts, and will lift 200 pounds through one inch.

The plunger is a close fit in the bore of the spool, which is closed at the top, and thus acts as a dashpot in checking the motion of the plunger. The third magnet is also of the ironclad plugged type, shunt-wound for 250 volts, and will lift 1,200 pounds through four inches, and 3,500 pounds through one inch. This solenoid is used for releasing a brake for the first

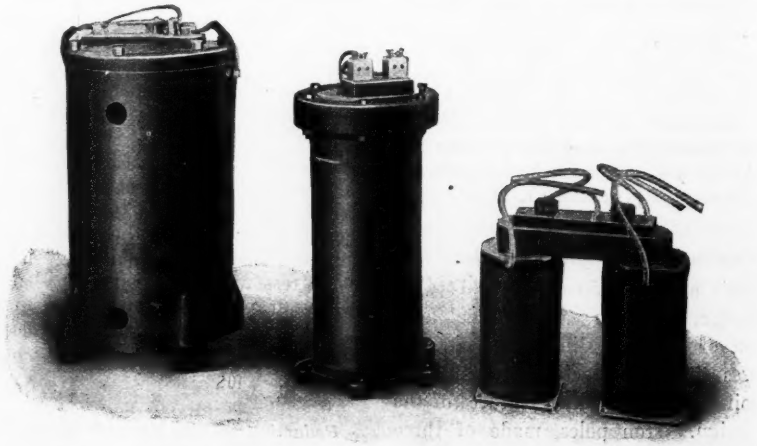


FIG. 3.—SINGLE-PLUNGER, IRONCLAD AND HORSESHOE ELECTROMAGNETS.

three inches of travel through its plunger, and also for actuating a seventy-two-inch clutch through the last inch of travel. The addition of the load imposed by the clutch in this case prevents the rapid ac-

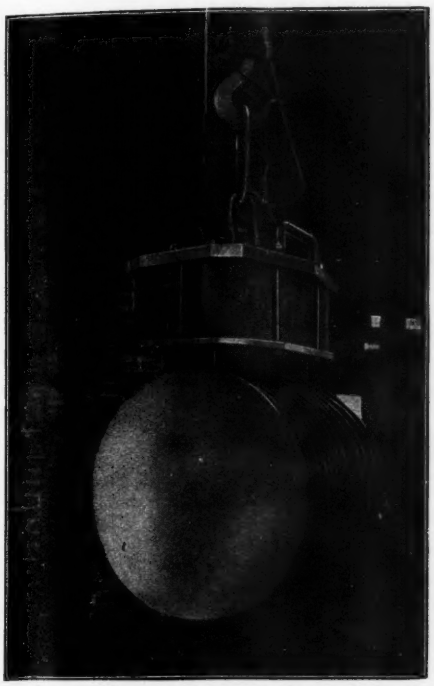


FIG. 4.—MAGNET HANDLING BOILER HEADS.

celeration of the plunger near the end of the stroke.

Fig. 4 shows a lifting magnet handling a number of boiler heads. The lifting magnets manufactured by the Electric Controller and Supply Company are designed for handling pig iron, and the various products of iron and steel, both during the process of manufacture and in the finished state. In all cases an electromagnet is used, suspended from the hook of an electric, steam, pneumatic or hydraulic crane. Direct current at any of the common voltages of distribution may be em-

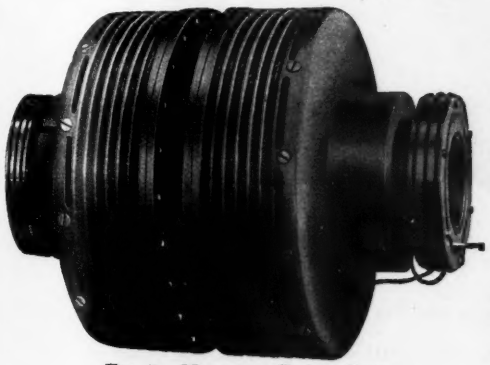


FIG. 5.—MAGNETIC PLATE CLUTCH.

ployed for energizing the magnet. Flexible cables are used for conveying current to the magnet, and the only additional apparatus, in general, required for the operation of the magnet consists of a small switch for connecting and disconnecting the winding of the magnet from the source of current supply.

In operation, the magnet is lowered upon the material to be lifted and the switch closed, thus causing the magnet to attract and hold the material, which may then be hoisted and transported to the desired point. By simply opening the switch, the material is instantly released.

As the lifting magnets are called upon for a variety of services, a single design is not adapted to handle the full range of material. The apparatus must, in each case, be designed to meet the form of material to be handled. A magnet which would handle five tons in the form of an ingot might not handle 500 pounds in the form of thin plates. It is therefore necessary to understand, in each case, the

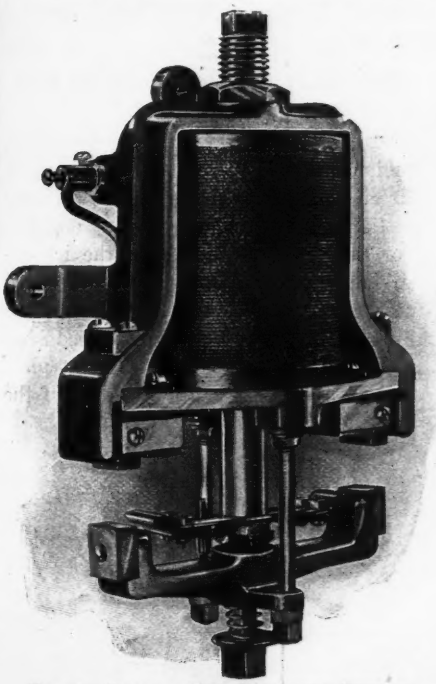


FIG 6.—GRAVITY-TYPE MAGNETIC SWITCH.

operating conditions, with special reference to the range and form of material to be handled.

Fig. 5 shows a magnetic plate clutch. This clutch eliminates the use of levers and toggle joints. It can be thrown into and out of action from any number of points by the manipulation of a small switch connected by wires to the source of current and the magnetizing winding of the clutch. In operation this form of clutch has a high efficiency, transmitting full power with no slip, and consuming a small amount of current. The company has in operation magnetic clutches transmitting forty horse-power, consuming one-half ampere at 110 volts. The clutch may be designed so that it will slip in starting, thus bringing its load up to speed gradually. In general, the driving member of the clutch is of considerable weight, and through its inertia serves the purpose of a flywheel in protecting the

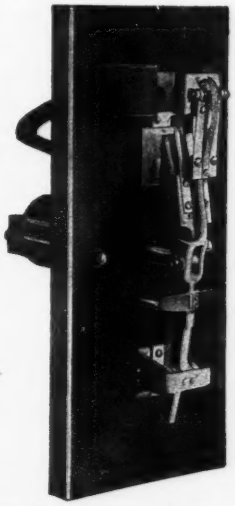


FIG. 7.—FRONT VIEW, CLAPPER-TYPE MAGNETIC SWITCH.

driving system from shock during the acceleration of the load.

In the apparatus shown herewith the friction element is composed of a plurality of friction plates, keyed alternately to the driving and driven elements, and constantly bathed in oil. This serves to lubricate the plates, and, at the same time, transmits the heat to the retaining case, where it is dissipated at the corrugated surface of the case.

Fig. 6 shows a gravity-type magnetic switch. This is regularly built in capac-

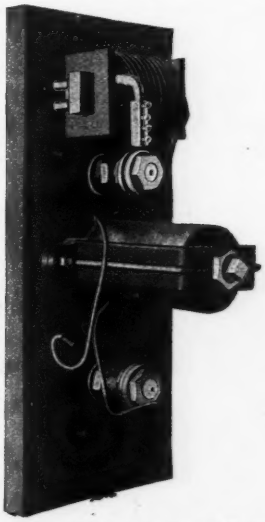


FIG. 8.—REAR VIEW, CLAPPER-TYPE MAGNETIC SWITCH.

ities from 1 to 150 amperes. The switch is closed by the direct action of a vertical electromagnet on a movable plunger which carries the contact arm of the switch. The switch is opened by the action of gravity

on the plunger and contact arm, the weight of which is sufficient to produce instantaneous separation of the contacts.

Fig. 7 shows a front view of a clapper-type magnetic switch, Fig. 8 showing a rear view of the same switch. The main contacts of the switch are of copper, and are protected by auxiliary contacts of carbon, so arranged that the final opening of the circuit always takes place at the carbons, protecting the main contacts from the effect of arcing. The construction of the switch is such that the frame of the electromagnet and the arm which carries the movable carbon contacts direct a heavy magnetic flux in the path of any arc which may be formed when the circuit is opened.

This switch is built for any capacity exceeding 150 amperes. The magnet core is horizontal, and the switch arm vertical. The switch arm is pivoted near its lower extremity, and is normally held open by a powerful spring, being closed by the movement of the plunger of an electromagnet yoked to the arm.

The switch arm is provided at its upper end with a heavy wedge-shaped contact of laminated copper, reenforced with auxiliary contacts of non-arcing metal and a final or breaking contact of carbon, these parts being arranged to contact with the stationary copper plate, also provided with a carbon block. The various parts are so disposed that the final opening of the circuit always occurs at the carbon contact. A powerful blowout magnet is provided, the poles of which are so disposed as to produce an intense magnetic flux between the carbon contacts. The winding of the blowout magnet is in series with the switch, so that the strength of the magnet is always in proportion to the current which must be broken.

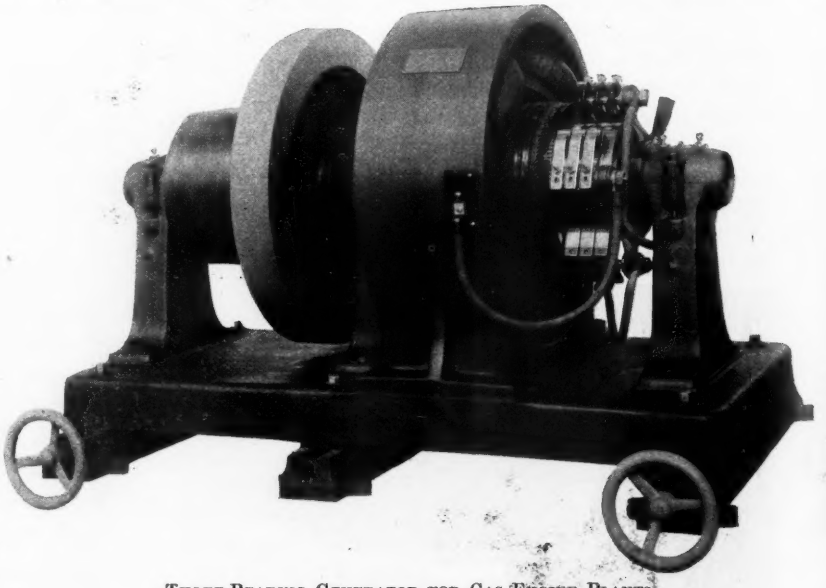
An Electric Automobile Test Run.

Some remarkable claims are being made by the Rhode Island Electromobile Company, Providence, R. I., for the new "Providence" battery, due to a recent test run from Providence to Boston on one charge.

The vehicle used in the test was a Waverly runabout provided with thirty-two cells and a two and one-half horse-power motor. On level roads the discharge averaged thirty amperes; on hills the variation averaged from sixty to seventy amperes; the highest discharge being 100 amperes. The company claims that the performance of the vehicle was all the more creditable because one of the cells was cut out two miles north of Pawtucket, which caused a drop of two volts, and the resistance of the copper wire used in cutting out the cell was also against the battery. However, at the end of the run the battery manifested no signs of exhaustion, and the cyclometer registered forty-seven and one-half miles. The voltmeter registered a drop of three volts, and as the limit of mileage is not reached until there is a drop of eight volts, it is evident that the machine could have gone a considerable distance further. The vehicle and cells are said to have been in regular service for a year and one-half and to have recorded 12,000 miles. In the construction of the cell, the active or working material is confined to the grid by a separator which keeps the plates apart, and while retaining the active material in its place in the grid, allows free circulation of the electrolyte to every part of the plate.

Three-Bearing Generators for Gas Engine Plants.

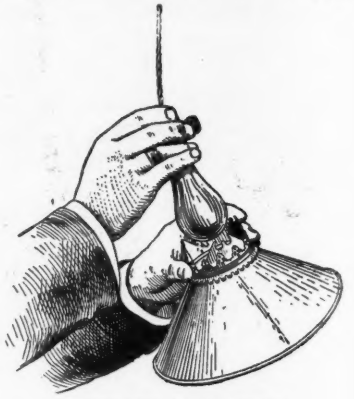
The Commercial Electric Company, Indianapolis, Ind., has designed a line of direct-current generators for use in connection with gas and gasoline engines. For this purpose, because of the irregular impulses of the engine, it is provided with a flywheel which will overcome the fluctuations of the dynamo speed and produce a steady light. Instead of placing the flywheel upon an extension of the armature shaft, this machine is fitted with an extra heavy shaft, which is extended to receive a heavy flywheel, and which is supported by three bearings, two of which are placed close upon either side of the flywheel, where they will support its weight and receive any extra strain caused by the pull of the dynamo belt. The three pedestals, with the machine frame, are mounted upon a heavy iron base, which is carried upon sliding rails with hand-wheels and thrust screws, by means of which the belt tension may be adjusted. The machines are made in the usual sizes, in capacities from one-half to thirty kilowatts.



THREE-BEARING GENERATOR FOR GAS ENGINE PLANTS.

An Automatic Lamp Shade.

The accompanying illustration shows an automatic lamp shade which the General Incandescent Arc Light Company,



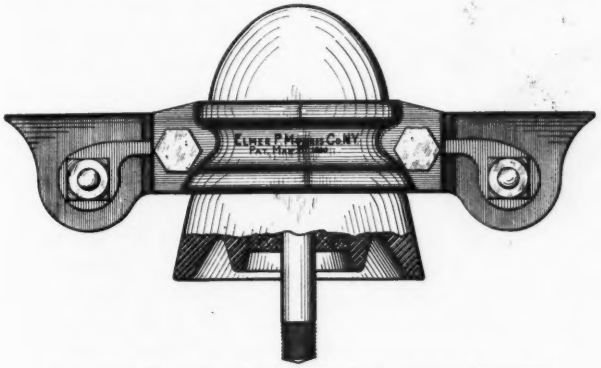
AUTOMATIC LAMP SHADE.

New York city, has placed on the market. This shade and holder can be instantly put on or removed from any size of electric lamp, from four to twenty-four candle-power, without removing the lamp from its socket, adjusting itself to the lamp automatically. In addition to the economy in time with the use of this shade, the company claims that it will increase the amount of illumination thrown down by the lamp. The shade may be used with an upright portable lamp by bending the arms up to right angles and adjusting from inside the holder.

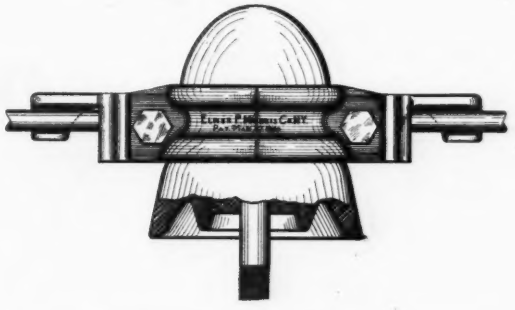
Line Material for Alternating-Current Railway Service.

The Elmer P. Morris Company, 15 Cortlandt street, New York city, has placed on the market a number of devices for alternating-current railway service, illustrations of which are shown herewith. The porcelain insulator used with this apparatus is of the highest grade manufactured by R. Thomas & Sons, East Liverpool, Ohio. There has been selected for the construction of this line material an insulator which R. Thomas & Sons guarantee to stand 8,500 volts in service.

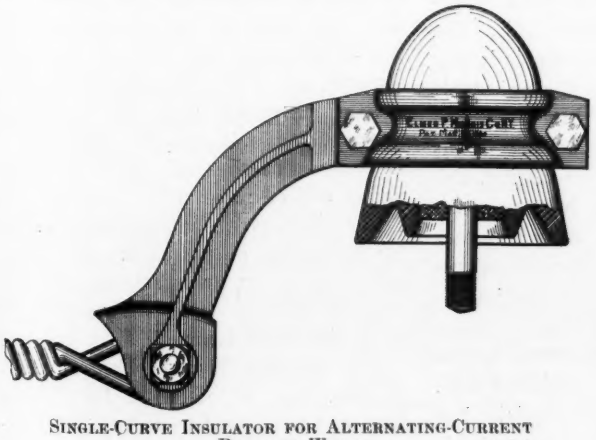
There are two forms of straight-line hanger, one having the span wire pass around the hanger in the usual manner, and the other having two porcelain bushings protected from the weather in the ends of the arms. This form requires the span or suspension wire to be cut.



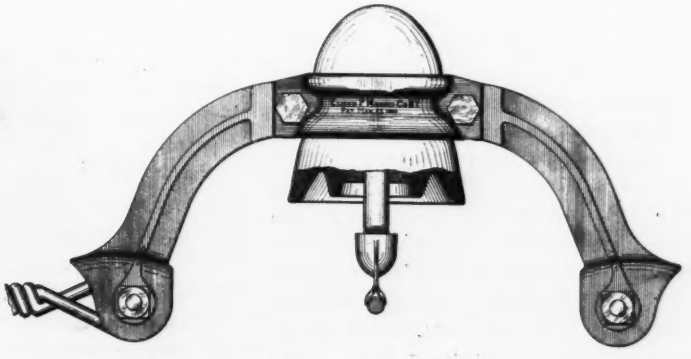
STRAIGHT LINE INSULATOR FOR ALTERNATING-CURRENT RAILWAY SERVICE.



STRAIGHT LINE INSULATOR FOR ALTERNATING-CURRENT RAILWAY SERVICE.



SINGLE-CURVE INSULATOR FOR ALTERNATING-CURRENT RAILWAY WORK.



DOUBLE-CURVE INSULATOR FOR ALTERNATING-CURRENT RAILWAY WORK.

The porcelain insulators in the ends of the arms are thoroughly protected from the weather, and act as an additional insulator. This form is used in the single and double-curve insulator.

The bolts upon which the ears are fastened are securely embedded in the porcelain. They are made in five-eighth and three-quarter-inch sizes so that the standard size of ear now in use may be employed. The insulators are made very heavy, so as to withstand hard usage on trolley lines.

Appreciating the difficulties due to the disintegrating effect of alternating currents for continuous service, this material has been designed to especially meet these requirements. The patents on these devices are for modifications of the patent taken out by Mr. Elmer P. Morris, president of the company, on May 27, 1890.

Mechanical Draught at St. Louis Exposition.

Of the buildings at the Louisiana Purchase Exposition two of the most interesting and thoroughly inspected are Machinery Hall and its nearest neighbor, the Steam, Gas and Fuels Building.

The 40,000 engine horse-power which has been provided is furnished by engines located in one end of the Machinery Building, while the entire space taken by the boilers themselves occupies a considerable part of the 100,000 square feet of floor space which the Steam, Gas and Fuels Building contains.

On approaching the exterior of this latter building one's attention is first attracted by the short steel stacks arising from the roof. These steel funnels are indicative of mechanical draught apparatus, which is furnished fans and engines by the Buffalo Forge Company, of Buffalo, N. Y., for a total of 16,600 horse-power boilers of various types. The stacks referred to are for the horizontal boilers only, the upright boilers, of which there are a number, having each its own separate and much smaller smoke pipe.

All of the boiler plants are of special interest, not only on account of the large capacity of batteries served, but because of the fact that they are expected to run continuously at from twenty-five to fifty per cent above rating. This requires an intense draught and fans running at unusually high speeds for such large units. Wherever possible duplicate fans have been installed, each one being of sufficient capacity to handle the entire load.

All of the fans are driven by direct-connected Buffalo horizontal engines, and a rigid substructure is employed to support the engines and outboard bearings, which carry the weight of the overhung blast wheel. A large bowl is provided in the engine side of the fan-housing and the substructure is extended into this space, allowing a water-cooled, self-oiling bearing to be placed close to the centre of gravity of the wheel. The fans

are heavily built and braced to support the weight of the stacks, which have ornamental tops and are built of one-quarter-inch and three-sixteenths-inch plate.

The first battery to be installed consisted of eight 400-horse-power boilers, builders' rating, Heine boilers, which, when running at twenty-five per cent overload, will deliver 4,000 horse-power. For this battery, two 240-inch Buffalo fans, with fourteen-foot blast-wheels, five and one-half feet wide, are used, each driven by a fourteen by fourteen centre-crank engine.

The maximum speed will be about 143 revolutions per minute, and in order to run economically at large variations in load the eccentric is controlled by a link motion adjustable while the engine is running. The throttling governors vary the speed, and thus in order to secure any desired draught pressure, the governor mechanism may be adjusted for the desired speed, and the link motion set to secure the earliest cut-off possible.

This feature has been adopted on all large induced draught installations made by the Buffalo Forge Company for some time and ensures economical operations at low speeds.

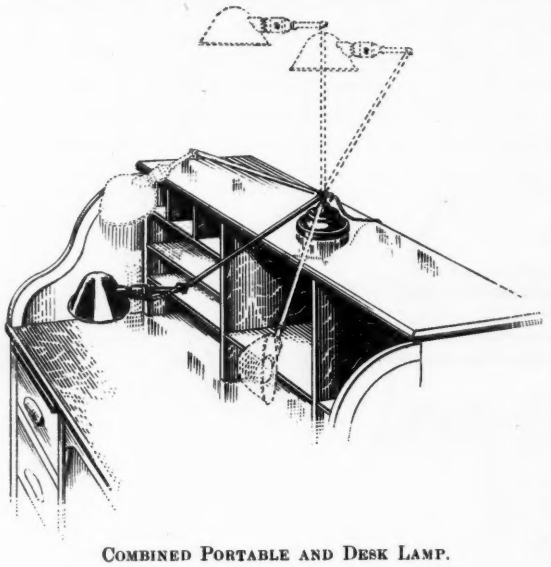
There are three independent groups of Cahall boilers of different types, the first two groups consisting each of four 508-horse-power boilers, which will be run up to fifty per cent overload, and on account of lack of space it has been impossible to furnish duplicate fans. For each of these groups the fan is a 210-inch, with a blast-wheel twelve feet four inches in diameter and forty-three inches wide, driven by a twelve by twelve engine at 220 revolutions per minute maximum. The third group of Cahall boilers is of approximately the same capacity as the Heine group, and the apparatus is of the same size.

The most prominent exhibit of foreign boilers is shown in the group including the Belleville and Niclausse types, the rated horse-power of which will be 1,700, and as it is expected that these marine boilers will be tested at a large overload, the induced draught fans, which are in duplicate, are designed for 2,550 horse-power each and will run at 175 revolutions per minute. These fans have blast-wheels twelve feet four inches in diameter and are four feet wide, driven by direct-connected twelve by fourteen engines.

All of the engines are of the piston-valve type, with removable bushings, forged-steel shafts and crossheads, and are of the same design and finish as regularly furnished for similar work by the Buffalo Forge Company.

Universal Portable and Desk Lamp.

"Universal" is the name of a new combined portable and desk lamp, which is being put on the market by the Central Electric Company, Chicago. It is entirely new and possesses many desirable features.



COMBINED PORTABLE AND DESK LAMP.

The lamp consists of an adjustable arm mounted on a finished base and is fitted with a parabolic shade, which serves as a reflector and may be moved by a touch to any desired angle without resorting to the loosening of screws. The shade is furnished with a patent holder attachment, which can be adjusted to fit any lamp at will. The adjustable arm admits of the light being instantly drawn forward or back or swung to right or left at pleasure without rising from one's chair. The distinctive feature of this portable is that the joint is so made that the adjustable arm is "self-maintaining" in any position in which it is placed. Its moving differs from other portables on the market, also in that, when changing it from one position to another, the only thing necessary is to swing the light into the desired position and the arm, being "self-maintained," remains there.

The finished base is felt-covered to prevent marring or injuring a polished desk, and the fact that the base weighs five and one-half pounds prevents the portable from becoming unbalanced when the arm is extended in any position of the different positions in which it may be used.

The portable is finished in polished brass or oxidized copper, and while the illustration shows it merely for a roll-top desk, it is adaptable for use in the drawing-room, for the piano, and for show windows and decorative lighting.

High-Speed Locomotive Tests in Germany.

In a report, United States Consul F. H. Mason, at Berlin, Germany, gives the results of the recent German tests with steam locomotives, which have already been noted in the ELECTRICAL REVIEW. The report states, in addition, that the Berlin engineer, Dr. W. Reichel, has made a comparison between the cost of steam and electric traction from the standpoint of German practice, as illustrated by the recent experiments with both motive powers. The steam train, with five cars and a standard locomotive, weighs 330 tons. It seats 168 passengers, and uses at full speed 1,400 horse-power. The electric train, with one motor car and four trail cars, weighs 260 tons, seats 180 passengers, and utilizes 1,000 horse-power. Each train and engine costs, for initial construction, about $100,000. The operating cost of the steam train is fixed by Dr. Reichel at twelve and one-half cents per 100-seat kilometres, and eleven and one-half cents, or one cent cheaper, for the electric train.

Indiana Independent Mutual Telephone Association.

The annual meeting of the Indiana Independent Mutual Telephone Association will be held at La Fayette, Ind., Tuesday, June 28, and Wednesday, June 29. From present indications this will be a large meeting, and it is expected that at least 200 representatives of operating companies will be present.

The programme committee has arranged for interesting sessions, and opportunity will be given for manufacturers to make complete exhibits. The headquarters will be at the Hotel Lahr.

The Sterling Electric Company, La Fayette, Ind., is located at La Fayette, Ind., and has agreed to undertake to furnish an elaborate entertainment for the convention. This company expects to have the cooperation of other telephone manufacturers and supply men in this direction.

Mr. Rome C. Stephenson is president; Mr. Charles M. Zion, vice-president, and Mr. Harry B. Gates, secretary and treasurer of the association. The office of the president is at Rochester, Ind.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW DUTCH CABLE IN THE FAR EAST—A syndicate of German and Dutch capitalists has been organized for the financing of a cable proposition from the Dutch island of Menado Tua, off the coast of Celebes, East Indies, to the island of Guam, and thence to Shanghai. Through a connection with the American cable, it is intended to eliminate British influence over the Dutch and German cable business with East Asia. A company for laying the cable will be formed with a capital of $1,750,000.

CHICAGO MUNICIPAL PROPOSITION—The city council of Chicago, Ill., has passed an order directing the legislative committee to prepare an act to be introduced at the next session of the legislature in January, permitting the city to issue certificates of indebtedness, enabling it to acquire and operate gas and electric light plants for municipal use and to supply the public with light and power. The council also ordered the same committee to prepare an act permitting the city to regulate the price of gas.

INDEPENDENT TELEPHONE DEVELOPMENTS—It is stated that the United States Telephone Company within the next sixty days will make important extensions to its long-distance service. The work will include connections between Dayton, Ohio, and Richmond, Ind., which will give complete long-distance connections through Indianapolis and St. Louis to Kansas City. Wires will be strung into Cincinnati and Wheeling, W. Va. In addition to this, many of the towns in Ohio not now having long-distance connections will be given them, and the old service will be increased.

THE STATEMENT OF THE NEW YORK CITY RAILWAY COMPANY—The consolidated statement of earnings and expenses of the New York City Railway Company for the year ending December 31, 1903, including the Metropolitan and Third Avenue systems, but excluding the Central Cross-Town Railroad Company, which was not leased to the Metropolitan company until April 1, 1904, shows gross earnings of $21,221,519, and expenses of $10,990,602. The net earnings are therefore $10,239,917, to which is added other income of $1,373,793, making the total income $11,604,710.

THE ALLIS-CHALMERS COMPANY—The annual report of the Allis-Chalmers Company for the year ended April 30, 1904, shows net profits of $952,624, and preferred dividends of $853,125, leaving a surplus of $99,499. Added to the previous surplus of $820,835, this makes a total of $920,334. The net profits, as given above, are after deducting operating expenses, reserve, depreciation, maintenance and repairs. The fiscal year will hereafter terminate on the last day of June in each year. The date of the annual meeting of stockholders will now be the first Thursday after the first Wednesday in September. This year the stockholders' meeting will be held at No. 15 Exchange Place, Jersey City, N. J., September 8, at 12 o'clock. In the course of his report, Mr. B. H. Warren, president of the company, says: "In the settlement of several business contracts entered into prior to March last, the company became the owner of $100,000 par value of its preferred stock and $180,000 par value of its common stock, which shares have been canceled, thus reducing the outstanding capital stock to $16,150,000 of preferred stock, and to $19,820,000 of common stock. During the past year the following expenditures have been made in the increase or for the greater economy in the operation of the productive property of the company: additions to plants, $642,232; new plant, $77,300; terminal railroad, $49,060. All of the property of the company is owned in fee, except the Bullock electrical works at Norwood, near Cincinnati, Ohio, the latter being held under a long lease."

MEXICAN ELECTRICAL NOTES—It is stated that a syndicate is in process of formation for the purpose of constructing a system of electric railways in the city of Parral, state of Chihuahua. The syndicate also purposes to build and operate an extensive long-distance system of telephones in the state of Chihuahua. The telephone line will be built to a number of the leading mining camps in the state of Chihuahua. The telephone line will be built to a number of the leading mining camps in the state of Chihuahua. Miguel S. Macedo and Jose Maria Velasquez have been granted a concession by the Mexican government, which will permit the establishment of an extensive electric power plant and irrigating system in the state of Guerrero. The electric lighting system in Vera Cruz is to be considerably extended which will mean the purchase of quite a large amount of equipment in the United States. Francisco Hernandez is manager of the estate which was granted a concession for establishing and working the system. An electric railway is to be constructed between Puebla Neuva and Navidad del Puerto, in the state of Jalisco. The line is to be built by the owners of the Puebla Neuva mines, who are European capitalists. The Mexican government has granted to the contracting firm of Mackin & Dillon, of Monterey, an extension of their concession for the construction and operation of an electric railway from Monterey to Villa Guadaloupe. The concession also gives the right for the building of electric lines in several of the principal streets of Monterey.

AUTOMOBILE NOTE.

THE AMERICAN AUTOMOBILE ASSOCIATION, touring committee, 7 East Forty-second street, New York city, N. Y., is announcing that continued interest in the St. Louis tour of the association, July 25 to August 10, 1904, is manifested by the constant request for entry blanks. A number of changes in the routes, as given in the official booklet, has been decided on, as follows: (1) An optional route is given from Cleveland to Clyde, Ohio, by way of Sandusky, along the shore of Lake Erie. Under certain weather conditions this may be preferable to the route as planned, through Elyria, Oberlin and Norwalk. (2) An optional route from Chicago to Joliet, by way of the west bank of the Illinois river. This gives a choice of routes on either side of the river. (3) A detour will be necessary at Effingham, Ill., on the National highway. At that point the route will follow a road about two miles north of the highway to a point a few miles east of Vandalia. (4) A detour in Indiana, from Indianapolis, passing south of Greencastle, to Rockville, and thence to Terre Haute, will give a route which, while twenty miles longer than the highway, is in some respects preferable. (5) By turning south at Springfield, Ohio, an interesting route through Dayton, Ohio, and Eaton can be secured. The distance is about ten miles further than by the National highway. (6) The route from Philadelphia has been changed to run through Reading and Harrisburg, instead of by way of York and Lancaster, as at first provided. It is also probable that an optional route from Syracuse will be arranged, by means of which it will be possible to avoid the Montezuma marshes.

ELECTRIC LIGHTING.

PORT LAVACA, TEX.—Work has begun on the electric light and ice plant, and it is expected to have it in operation within sixty days.

TOPIO, MEXICO—Miguel Morga, of this city, has been granted a concession by the Mexican government for the establishment of an electric light and power plant.

WILKESBARRE, PA.—Ground has been broken for the erection of a new power plant at North Franklin colliery, Trevorton, from which electric power will be supplied for lighting the breaker and mines and for mine haulage.

MONTGOMERY, ALA.—The Montgomery Light and Water Power Company has secured a temporary injunction against the Citizens' Light, Heat and Power Company, seeking to restrain it from stringing wires on certain streets as allowed by the city council.

STROUDSBURG, PA.—Local capitalists will oppose the erection of an electric power plant at the Water Gap by the Delaware Water Gap and Power Company, which is composed of Philadelphians. The plan is to combine the waters of Brodhead and Cherry creeks and erect a power plant at the Gap, where there would be a head of 100

feet of water. Local parties interested in a similar enterprise assert that the taking of water from the creeks would interfere with their rights.

VIDALIA, LA.—The Interstate Electric Company, New Orleans, has turned over to the city the municipal electric lighting plant, for which $15,000 bonds was voted last year. The plant cost $10,000. It has a seventy-five-horse-power engine, eighty-five-horse-power tubular boiler and furnishes fifty arc lights and 400 incandescents.

REDDING, CAL.—The city of Eureka, in Humboldt County, is to be supplied with electric power and lights from a plant to be installed immediately at Junction City, Trinity County. The company interested is the North Mountain Power Company. John M. Vance and William Carson, of Eureka, are among the principal directors. The distance by pole line from the proposed power plant in Trinity County to Eureka is sixty-five miles.

NORFOLK, CT.—As the result of the failure of the Norfolk Electric Light and Power Company to reach an agreement with the town of Norfolk for the continued lighting of the streets, the company has decided to discontinue the lighting branch of its business. Several capitalists have made arrangements to organize a new company, and to establish an electric lighting plant on Mill river, and to supply lights to both Norfolk and Canaan. A valuable water privilege will be utilized.

LITTLE FALLS, N. Y.—The Herkimer County Light and Power Company has entered into a contract with the officers of the village of Mohawk to furnish electricity for lighting the streets of the village and for pumping water for the village waterworks. The lamps, poles and wires that have been used by the village will be used by the power company, and a high-tension line will be laid on the south side of the river between Little Falls and Mohawk, which it is expected to have completed before September.

WEST PALM BEACH, FLA.—A meeting of the board of directors of the East Coast Electric Light, Power and Ice Company was held recently, when the resignations of A. P. Anthony and J. R. Anthony, Jr., were received as members of the board. The resignations were accepted, and the vacancies filled by the selection of George W. Potter and Wallace R. Moses. The resignation of A. P. Anthony also included his giving up the position of treasurer, and George W. Potter was unanimously elected his successor.

PENTWATER, MICH.—A contract has been entered into between the village and the Oceana Electric Company, as a result of which the company will operate the local water plant, and will also install equipment to furnish twenty arc lights for the village and current for private consumers at fifty cents per thirty-two candle-power incandescent lamp. Arc lights are to be of 1,000 candle-power, and to cost $75 per month for the entire twenty lamps. The contract is for ten years, and the plant is to be installed before December 31 of this year.

HARTFORD, CT.—The Hartford Electric Light Company has leased from the Hartford & New York Transportation Company a tract of land on the Connecticut river front at Dutch Point and will utilize the property as the site for a large power plant. The plant will take the place of the present station, which is located at a considerable distance from the river. It is believed that a large saving in the transportation of coal and in the supply of water can be effected. The present steam plant, including the big turbine wheel and boilers, will be moved to the new plant, and it is expected that an additional turbine will be installed.

CHESHIRE, CT.—The New Milford Power Company, which is to transmit electric power from its plant on the Housatonic river, in Litchfield County, to this place for the operation of the trolley cars of the Connecticut Railway and Lighting Company, is having considerable difficulty in getting the needed right of way for its pole line between Cheshire and Milldale. As soon as the rights of way are secured the work of erecting the poles and stringing the wires will be pushed as rapidly as possible. The Connecticut Railway and Lighting Company has completed its transforming plant at this place. The dimensions of the station are 100 by 140 feet. The capacity of the plant here will be about 1,800 horse-power. The transformer plant at Waterbury is already in operation; the one at Cheshire will be ready in a few weeks, and the one for the New Britain district will be ready for use somewhat later.

NEW INCORPORATIONS.

NASHVILLE, TENN.—The Gass Bridge Telephone Company. $300.

MADISON, WIS.—Westby Telephone Company. Increased to $10,000.

ST. PAUL, MINN.—The White Bear Electric Company. Increased to $25,000.

BERKLEY, VA.—The Bott & Lewis Railway Company. Increased from $5,000 to $10,000.

ROCKFORD, OHIO—Rockford Toll Line Telephone Company. Increased from $10,000 to $20,000.

DES MOINES, IOWA—Cedar Falls Mutual Telephone Company. $25,000. Incorporators: N. H. Harris and others.

QUINCY, ILL.—German Telephone Company. $500. Directors: Andrew Bartell, Menne Gronewald, D. G. Buss and others.

PRAIRIE DU CHIEN, WIS.—Star Telephone Company. $14,000. Incorporators: M. Menges, J. A. Haggerty and Lawrence Case.

REDDICK, ILL.—Reddick Mutual Telephone Company. $5,000. Incorporators: James Reilly, I. G. McLane, William McGinnis.

DES MOINES, IOWA—Orilla Telephone Company. $600. Directors: George Allis, P. M. Turner, John McClain and others.

AUGUSTA, ME.—Sebec Power Company. $1,000. President, Crowell C. Hall, of Dover; treasurer, Frank E. Guernsey, of Dover.

JOHNSTON CITY, ILL.—Johnston City Telephone Company. $8,000. Incorporators: C. E. McLintock, W. A. Roberts, J. E. Carr.

NASHVILLE, TENN.—The Tracy City Electric Light and Power Company. $5,000. Incorporators: Samuel Werner, C. E. Werner and others.

PORTLAND, ME.—The Galesburg Railway and Light Company. $1,500,000. President, G. F. Duncan; treasurer, E. Woodman, both of Portland.

INDIANAPOLIS, IND.—The Stampers Creek & Orleans Telephone Company. $200. Incorporators: H. McCoy, S. Cornwall and B. F. Williams.

STEEL CITY, PA.—Steel City Electric Company. $5,000. Directors: William I. Patterson, Adolphus K. Springer, George R. Mathieu, Pittsburg.

COLUMBUS, OHIO—The Morral Telephone Company. $10,000. Incorporators: J. A. Baer, S. C. Baker, G. E. Morral, W. G. Lupton and W. H. DeRoche.

BIRMINGHAM, ALA.—The Standard Telephone and Telegraph Company. $25,000. Incorporators: Charles Henderson, W. C. Cameron and Lane Enzer.

DULUTH, MINN.—Chisholm Light and Power Company. $25,000. Incorporators: Daniel D. Crowley and H. A. Liedel, Duluth; Nils Anderson, Virginia.

RALEIGH, N. C.—The Wilson Light and Power Company. $125,000. Incorporators: J. C. Hales, B. T. Lane, Claudius Aycock, W. L. Cantwell and David Daniel.

NEWARK VALLEY, N. Y.—The Northern Tioga Telephone Company. $10,000. Incorporators: G. E. Purple, F. W. Witter and H. L. Knapp, Newark Valley.

UPPER ALTON, ILL.—Petersburg & Upper Alton Main Line Telephone and Telegraph Company. $2,500. Incorporators: John S. Culp, Albert A. Penning, W. M. Cartwright.

FORESTVILLE, N. Y.—Conewango Valley Home Telephone Company. $11,000. Incorporators: A. H. Libby, Forestville; E. B. Crissey, Jamestown; B. C. Wilson, South Dayton.

LOS ANGELES, CAL.—The San Fernando Valley Home Telephone Company. $50,000. Directors: C. F. Guthridge, C. L. Zahn, A. Wright, D. F. Boyce and C. P. Platt, all of Los Angeles.

MT. STERLING, KY.—The Mt. Sterling Short Line Railroad

Company. $250,000. Incorporators: William Beckner, J. M. Pickerell, B. R. Jouett, Lucien Buckner and E. S. Jouett, of Winchester.

HARRISBURG, PA.—Arbutus Park Street Railway Company. $18,000. To build a road from Johnstown to Geisstown, three miles. President, Lewis C. Coldren, Johnstown; directors, Jacob Grosch, George E. Conrad, Bernard Nees, William C. Kreiger, George M. Harshberger, Johnstown.

PERSONAL MENTION.

MR. CHARLES R. GUERTLER, of the Engineering Company of America, New York city, is making an examination of the route for the proposed Roanoke and Mount Airy electric railroad.

MR. W. L. ABBOTT, who is chief operating engineer of the Chicago Edison Company, was recently nominated as one of the trustees of the Illinois State University. Mr. Abbott is an alumnus of the University, class of '84.

MR. FRED BILLINGS, formerly chief engineer of the Manitowoc & Northern Traction Company, Manitowoc, Wis., has recently been appointed chief engineer of the Sterling, Dixon & Eastern Electric Railway, Sterling, Ill.

MR. WILLIAM M. EATON, second vice-president and general manager of the Grand Rapids Gas Light Company, recently resigned, to accept a position as general manager of the gas and electric properties of the Rochester Railway and Light Company.

MR. FRANK CARPENTER, who was formerly connected with the National Car Wheel Company, Pittsburg, Pa., recently tendered his resignation to the company, to accept a position with the Westinghouse Electric and Manufacturing Company at its Philadelphia office.

MR. H. H. WEBB, who is general manager of the Maryland Telephone and Telegraph Company, Baltimore, Md., and Mr. J. J. Comer, who is assistant general manager, recently returned home from an extended trip of inspection of telephone plants in various western cities.

MR. WALLACE C. JOHNSON, consulting engineer of the Niagara Falls Hydraulic Power and Manufacturing Company, is reported to have been engaged by the Sientere Viva Mining Company, Bluefields, Nicaragua, to prepare plans and specifications and to construct and equip an extensive electric power plant and transmission system in that locality.

MR. MASON D. PRATT, who graduated from Lehigh University, class of 1887, and since that time has had considerable experience in the practice of engineering, has opened an office as consulting engineer at 18 North Third street, Harrisburg, Pa., and is prepared to make surveys, plans and specifications, and to supervise the construction of electric railways, power plants, waterworks and industrial plants.

MR. H. S. KEMP, electrical engineer connected with the Standard Electric Company, Norfolk, Va., and Charlotte, N. C., has been appointed by the Tazewell Electric Light and Tazewell Street Railway Company, Tazewell, Va., consulting engineer to prepare plans and specifications for the extension and reconstruction of its light and railway plant. Mr. Kemp is a man of much experience in the construction and management of electric light and railway plants.

MR. F. S. PEARSON, who is vice-president and chief engineer of the Mexican Light and Power Company, the Canadian syndicate which is building the Necaxa, Mexico City & El Oro power transmission system in Mexico, recently returned to New York, after having inspected the plant, which will have an initial capacity of 45,000 horse-power and an ultimate development of, it is estimated, not less than 80,000 horse-power. The New York office of the company is at 29 Broadway, and now that Mr. Pearson is here it is expected that some important contracts for equipment will be given out.

MR. SALVADOR UGARTE, of Guadalajara, Mexico, who is an electrical engineer and contractor, is quoted as having said: "The most notable advance in matters of electrical installation in Mexico has taken place in the last five years. Of course outside of the city of Mexico electric railways are yet comparatively in their infancy but there is great development of electric light and power production. The most important plant in Mexico when completed will be that now being built at the Necaxa Falls, near Puebla, where the drop of water is 1,000 feet and where it is proposed to develop 200,000 horse-power for distribution to the surrounding country, including the city of Mexico, which is 150 miles away."

ELECTRICAL SECURITIES.

While there was a little animation evident in the interest shown in the stock market last week, the advance in prices and the growth in confidence were considerably in excess of expectations. It is well known that a number of speculators who have been prominent in the bear faction for some time have come to a realization that the moment is about due to change their position and help to uplift the market. In fact, it is broadly hinted in many quarters that prices will not go any lower, because there is nothing to sell. The investing public remains chary of placing any confidence in the commission houses at the present time, but this is largely due to the fact that it lost heavily up to about six months ago, and the industrial conditions since that time have not been such as to make possible much accumulation. While the early part of May reflected declines in railroad earnings, it is announced that the reports at the end of the month brought out a much better condition, and the traffic movements for the first part of June are satisfactory. The continued promise of bountiful crops, and the ease with which the large banks are viewing the monetary situation, are bringing about a condition of optimism even where the most pessimistic sentiment has been prevailing.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JUNE 11.

New York:	*Closing.*
Brooklyn Rapid Transit	48⅜
Consolidated Gas	190
General Electric	157½
Kings County Electric	188
Manhattan Elevated	144⅜
Metropolitan Street Railway	113⅞
New York & New Jersey Telephone	143
Westinghouse Manufacturing Company	175

A dividend of $2 per share will be paid on July 15, 1904, to stockholders of the General Electric Company of record at the close of business hours on Wednesday, June 15, 1904.

A quarterly dividend of 2 per cent will be paid July 1, 1904, to stockholders of record of the Commercial Cable Company on June 28, 1904. The transfer books will be closed June 28 and reopened July 5.

The board of directors of the Western Union Telegraph Company has declared a quarterly dividend of 1¼ per cent upon the capital stock of the company, payable July 15, 1904, to shareholders of record at the closing of the transfer books on June 20. The transfer books will be closed at three o'clock on the afternoon of June 20 and reopened on the morning of July 1.

Interborough Rapid Transit directors have declared a dividend of 2 per cent, payable July 1, to holders of record June 20.

The general balance-sheet of the Metropolitan Street Railway Company, as of December 31, 1903, shows total assets of $53,789,705 and liabilities of $91,515,560, leaving a surplus of $4,726,746.

Boston:	*Closing.*
American Telephone and Telegraph	128½
Edison Electric Illuminating	234
Massachusetts Electric	71
New England Telephone	119
Western Telephone and Telegraph preferred	81

Philadelphia:	*Closing.*
Electric Company of America	8 9/16
Electric Storage Battery common	54½
Electric Storage Battery preferred	54½
Philadelphia Electric	5⅛
Union Traction	49⅞
United Gas Improvement	82½

A dividend of 1½ per cent has been declared on Union Traction stock, payable July 1, as registered June 9. Books will remain closed from June 9 to July 1.

United Gas Improvement directors have declared the regular quarterly dividend of 2 per cent, payable July 15 to stock of record June 30.

Chicago:	*Closing.*
Chicago Telephone	119
Chicago Edison Light	142
Metropolitan Elevated preferred	56
National Carbon common	26½
National Carbon preferred	101
Union Traction common	5½
Union Traction preferred	29

TELEPHONE AND TELEGRAPH.

NEWARK, N. J.—The Reading telephone system has extended its lines to Clover Hill.

CLEVELAND, OHIO—The Cleveland Telephone Company has opened an exchange at Gates Mills.

BATAVIA, N. Y.—The Interocean company will construct a line from Sperry's Corners to Pavilion Center.

OXFORD, N. J.—The West Jersey Telephone Company has extended its lines from Washington to Oxford.

SYRACUSE, N. Y.—Arrangements are being made for an extension of the Parker-Newton telephone line to Erieville.

MADISONVILLE, KY.—The Cumberland Telephone Company will improve its system in this city at a cost of $8,000.

WINCHESTER, TENN.—The Cumberland Telephone Company has put in a copper line direct from Winchester to Nashville and Chattanooga.

SAN DIEGO, CAL.—Announcement is made that the Sunset Telephone Company has arranged for the extension of its service from here to Imperial.

SALT LAKE CITY, UTAH—The Vernal & Fort Duchesne Telephone Company has begun to construct an extension to Jensen, a distance of fourteen miles.

ALVORD, TEX.—F. M. Proctor, of this place, is building a telephone exchange which, when completed, will have connection with the Southwestern company's long-distance lines.

SCRANTON, PA.—The Anthracite Telephone Company, which recently was granted a franchise by the council of Forest City, is making preparations to install an up-to-date system.

TAYLORVILLE, ILL.—An independent telephone company has been organized at Assumption with a capital stock of $5,000. The incorporators are Silas Shafer, I. L. Long and S. T. Long.

NORTH WEARE, N. H.—The Weare Telephone Company has been organized with the following directors: Frank Simons, William S. B. Herbert, Seth Straw, Loran Clement and Dudley H. Farr.

OTTAWA, OHIO—The Ottawa Mutual Telephone Company has organized by the election of J. H. Purnell as president; Dr. E. L. Tuper, vice-president, and Dr. C. O. Beardsley, secretary and treasurer.

CHEHALIS, WASH.—The rural telephone line from Mossy Rock to Chehalis, a distance of thirty-five miles, has been completed, as well as a side line from Silver Creek, four miles up the Cowlitz river.

NATCHEZ, MISS.—The telephone line to Kingston, this county, has been completed, and the work of building a line from Vidalia, La., to Jonesville, La., on the Natchez & Western road will be commenced.

MADISONVILLE, KY.—The Rural Telephone Company of Hopkins County has been incorporated by W. N. and W. B. Bailey and M. F. Allen. The company will build lines throughout the county, and will extend to Muhlenburg and perhaps other counties.

QUAKERTOWN, PA.—Application has been made for a charter for an independent telephone line to be operated in the upper end of the county under the name of the Franklin Telegraph and Telephone Company. Among those interested are H. S. Funk, W. F. Witte and N. S. Rice.

WASHINGTON, D. C.—It is reported that Panama has granted to the United Fruit Company a fifteen-year concession for the operation of a system of wireless telegraphy between Panama, Colon, Bocas del Toro, and the Bay of Limon and Central and South American nations.

HOUGHTON, MICH.—The Michigan Telephone Company will this summer install new lines between Houghton, Calumet and Lake Linden, in order to increase the efficiency of its service. A new 200-wire submarine cable for use between Houghton and Hancock has already been ordered.

BLUFFTON, OHIO—The Mount Cory Farmers' Mutual Telephone Company has been organized with the following officers: president, W. A. Williamson; vice-president, S. F. Whisler; secretary, Milton Steininger; treasurer, Robin Bowersox; trustees, Oliver Flick, O. F. King and L. A. Bubler.

ATLANTIC CITY, N. J.—The new long-distance service of the Interstate Telephone Company between Atlantic City and the outside world has been opened. It connects with the Eastern company, of Camden, for New Jersey, and with the Keystone system, of Philadelphia, for the South, New York and Philadelphia.

GREEN BAY, VA.—The Southside Telephone Company, with headquarters at Worsham, Va., has completed its line from this place to Farmville, giving connection with Burkeville, Rice's Depot, Prospect, Hampden-Sidney, Keysville, Charlotte Courthouse, Drake's Branch and intermediate points. Connection will be had at Meherrin, Va., with the Lunenburg company's line.

MILWAUKEE, WIS.—It is stated by Mr. A. L. Hutchinson, president of the Independent Consolidated Telephone Company, that Milwaukee will, within a year, have toll connections with all the independent telephone companies in the state. The main line, now under construction, will connect the cities of Dubuque, Iowa, and Milwaukee, and will be used as a trunk line for the other independent companies to connect with.

KANSAS CITY, MO.—The Bell Telephone Company has begun estimates for a long-distance line between Kansas City and Joplin, to connect with a new line that is being built from St. Louis to Joplin, and thence through the Indian Territory into central Texas. Over a million dollars has been appropriated for these extensions, which, it is stated, with the Bell connections east of St. Louis, will make the longest telephone line in the world.

NEW CASTLE, IND.—Improvements to the extent of $25,000 are being made by the two telephone companies here—the Central Union and the Independent. Several miles of new cable are being put in and extensions of lines into the county in different directions are being made. The work was commenced several weeks ago, and will require all summer to complete. Several of the toll lines are being doubled on account of heavy business.

CHATTANOOGA, TENN.—The estimates for a long-distance telephone line between Chattanooga and Gadsden, Ala., have been accepted by the Southern Bell Telephone Company, and work will be commenced without delay. The line will follow the Alabama Great Southern Railroad, and the contract provides for four copper circuits with a twenty-foot pole line, the work to cost over $50,000. This will give Gadsden direct connection with all east Tennessee towns.

TROY, N. Y.—The Rensselaer Telephone Company, which is soon to be known as the Commercial Telephone Company, is rapidly extending its lines in Rensselaer County. Wires are being strung through the towns of Brunswick and Poestenkill, and already the company has installed connections with Cropseyville and Center Brunswick. The work of extending the lines through Greenbush will be inaugurated shortly and the company expects to be able to connect with Rensselaer before the end of the summer.

NEW YORK, N. Y.—The New York Telephone Company has reduced the rate for telephone messages between Manhattan and Brooklyn from twenty to fifteen cents, the rate to apply to all of Brooklyn. The charges for telephoning to the various towns in Richmond and Queens will be reduced shortly, and in the Bronx there will be some reductions in charges to outlying districts. The changes will apply only to the public telephones, the regular subscribers paying the same amounts as heretofore.

DETROIT, MICH.—It is announced by President W. A. Jackson, of the Michigan State Telephone Company, that a deal has been closed with the Pere Marquette whereby the telephone company acquires more than 1,000 miles of right of way over the routes of the Pere Marquette in Michigan. Upon this new right of way new trunk lines will be built. It is stated that at the end of this year there will be more than 70,000 subscribers connected with the system, an increase of 15,000 for the year, and that there will be, approximately, 36,000 miles of copper metallic circuits in the interurban toll system. A feature of this year's development is in the great number of farmers' telephones which have been installed, more than 2,000 having been put in in Washtenaw County alone within the last six months.

ELECTRIC RAILWAYS.

DES MOINES, IOWA—It is reported that an electric line from Reinbeck to Grundy Center is contemplated, and also one from Dyersville to New Vienna.

DOUGLAS, GA.—At a meeting, recently, of the directors of the Wadley & Mt. Vernon Extension Railroad it was decided to complete the road from Douglas to Leilaton.

ALBANY, N. Y.—The Rochester & Eastern Rapid Railway Company has filed with the secretary of state a certificate of increase of capital stock from $500,000 to $1,500,000.

CORNING, N. Y.—The common council has granted a franchise to the Elmira & Corning Short Line to construct its road through the streets of this city. The line will be built this year.

RICHMOND, VA.—The Citizens' Rapid Transit Company announces that contracts have been let for the proposed line to Fulton. The road will cover a part of the city not now served by electric lines.

NEWPORT NEWS, VA.—The Phoebus town council has ordered the charter of the Hampton Roads Railway and Electric Company revoked, because of the failure of the company to comply with the provisions of its charter.

RICHMOND, VA.—It is understood that the officials of the Chesapeake & Ohio Railway Company are considering the question of establishing an electric plant here for the purpose of furnishing light and power for its buildings.

SEATTLE, WASH.—The work of construction on the new Seattle-Everett electric railway has begun at Ballard. From now on the work will be pushed as rapidly as possible, so that the Ballard end of the line may be completed within the stipulated six months.

PITTSBURG, PA.—Permission has been given by the county commissioners to the Wilkinsburg, Turtle Creek & East Pittsburg Street Railway Company to build a double-track road on the Greensburg pike. The line will run from Wilkinsburg to East Pittsburg, a distance of four miles.

FOND DU LAC, WIS.—The Eastern Wisconsin Electric Railway and Light Company expects to commence the work of constructing its private line into the city of Oshkosh soon, a franchise granting the company the right to use certain streets having already been granted by the common council of that city.

HARTFORD, CT.—The Cheshire Street Railway Company has awarded the contract for the construction of the Waterbury & Cheshire trolley line to Ley Brothers, of Springfield, Mass. The line will be run from Cheshire to a connection with the Connecticut Railway and Lighting Company's tracks in Waterbury.

APPLETON, WIS.—A new interurban road from Appleton to Seymour, a distance of twenty miles, is to be built at once by the Outagamie County Construction Company. Most of the capital will be furnished by Chicago parties. Articles of incorporation have been perfected and the capital raised from $30,000 to $300,000.

RUSHVILLE, IND.—The Indianapolis & Cincinnati Traction Company is, it is stated, again contemplating a change of route, and has not let the contract for grading, as expected. It has withdrawn its surveyors from the Connersville route, the reason given being that the parties along the right of way asked exorbitant prices for their land.

LORAIN, OHIO—The new addition to the Beach Park power plant on the Lake Shore electric railroad, erected at a cost of $100,000, is now furnishing power between Lorain and Bellevue, and on the Sandusky branch as far as Milan. The substations at Milan and Monroeville are to be cut out, and upon the completion of the substation at Sandusky the power plant at that place will be abandoned.

WORCESTER, MASS.—Judge Francis A. Gaskill, of the Superior Court, has granted a decree allowing Charles M. Thayer and John A. Hall, receivers of the Worcester & Southbridge street railway, to sell the road for not less than $300,000 at private sale. It is understood that the syndicate, headed by William E. Rice, of this city, will purchase the road, together with the allied lines which were involved in the failure last August.

YOUNGSTOWN, OHIO—It is announced that two additional electric lines will reach Avon park next season. One will be that promoted by Messrs. Stombaugh and Jackson, and the other is one that is to be owned and capitalized by the park's stockholders. The latter line is to run from this city to the park north of the Mahoning Valley Railway Company's line, and will continue on to Warren. It is to be known as the Youngstown, Avon & Warren Railway, and it is said that the route has already been surveyed.

DENVER, COL.—Articles of incorporation have been filed with the secretary of state by Caldwell Yeaman, Samuel Newhouse, Edward H. Blanc, Charles C. Parsons, Frank W. Loveland and Harry Brown for the Denver & Intermountain Railway. The company succeeds the Denver, Lakewood & Golden road, operated by steam power, and will convert it into an electrically operated line. Extension will be made to Idaho Springs, and probably to Black Hawk, Central City and Georgetown. The capital stock is $514,000.

WEST CHESTER, PA.—The charter for the Oxford, Cochranville & Parkesburg Electric Railway has been filed in the recorder's office here. The route of the proposed road begins at the borough of Oxford and runs along Limestone road, through Hayesville and Russellville, to Cochranville; thence east through Highland township to Highland School, to Parkesburg. The entire distance is about fourteen miles. Thomas E. O'Donnell, of West Chester, is the promoter, and states that all the right of way has been secured. The company has a capital stock of $84,000.

KANSAS CITY, MO.—The preliminary survey for an electric line extending from Bethel, Kan., eight miles northeast of Kansas City, Kan., on the Kansas City-Leavenworth electric line, to Bonner Springs, is being made for the Kansas City & Bonner Springs Railway Company, recently organized under the laws of Kansas. The distance from Bethel to Bonner Springs is nine miles. Arrangements have been made with the Kansas City-Leavenworth electric line to have the Bonner Springs cars run over its line from Bethel to Kansas City, Kan. It is the intention of the promoters to ultimately push the line on to Topeka.

WATERBURY, CT.—The new trolley line of the Connecticut Railway and Lighting Company between this city and Cheshire will represent, when completed, an outlay of $175,000 for eight miles of single track, making it one of the most costly stretches of electric line in the state. The unusually large construction expense is due to the great amount of grading and cutting required on account of the many hills which lie along the route. The road is now being built by Springfield contractors. It will unite at Cheshire with the Connecticut Railway and Lighting Company's present line from Mt. Carmel. At the latter point cars now connect with the branch of the Consolidated Railway line to New Haven.

ALLENTOWN, PA.—The Philadelphia & Lehigh Valley Traction Company's bondholders have adopted a reorganization plan presented by J. C. Dawson, of Philadelphia. The entire system will be made compact with a new first mortgage for $4,600,000, of which $1,830,000 is to represent cash for the company's use in building a new power-house, light plant and machine shop, paying preferred claims and receiver's certificates and redeeming securities pledged as collateral. A second mortgage of $200,000 will be distributed among the present bondholders of the various lines, preferred stock will be issued to pay the balance of the bonds, general creditors and preferred stockholders, and $751,000 is to be raised by assessment on the present security holders, they to receive first mortgage bonds with a bonus of preferred stock. A syndicate will underwrite all assessments.

CHAMBERSBURG, PA.—The engineering corps of the proposed Catoctin & Myersville Electric Railroad has completed the survey to Pen Mar, where connection is made with the Chambersburg, Gettysburg & Waynesboro trolley line. The line as surveyed runs from the Frederick-Middletown line at Myersville to Pen Mar station, on the Western Maryland Railroad, a distance of twenty-two miles. It goes by Foxville, thence by Euclid, and then follows the Pen Mar road to the park and to the Chambersburg, Gettysburg & Waynesboro terminal. The stockholders of the new road have elected the following officers: president, J. H. Maugans; vice-president, A. L. Hauver; secretary, H. H. Warrenfeltz; treasurer, Charles U. Grossnickle. The stock of the company is nearly all subscribed and the work of securing right of way is far advanced. It is hoped to begin operations in a few weeks.

INDUSTRIAL ITEMS.

THE EWING-MERKLE ELECTRIC COMPANY, St. Louis, Mo., is distributing an attractive mailing card bearing the title of "Fishing Made Easy." This deals with the use of "Circular Loom" and its advantages in all kinds of construction work.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is mailing a postal card which shows the ticonic suspension bridge at Waterville, Me. This bridge has been painted with Dixon's silica graphite paint for protection and effect. This paint is manufactured in four colors.

THE NEW YORK EDISON COMPANY, 55 Duane street, New York city, in its bulletin for June, 1904, describes the new electric power service at McComb's Dam bridge. The text is supplemented by illustrations. In addition to this there are a number of sketches showing the use of the Edison service, with illustrations.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., announces that it is prepared to furnish "D. & W." fuses and blocks up to 800 amperes, in both 250 and 500 volts. The company states that the demand for "D. & W." material is still increasing, and that it is receiving continually commendatory letters from users.

THE SUMTER TELEPHONE MANUFACTURING COMPANY, Sumter, S. C., is calling attention in several bulletins to some of its new telephone apparatus. This includes the Sumter "Bull's-Eye" express switchboard, the "S. T. M." intercommunicating telephone central energy system, and a general catalogue showing telephone parts.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, 529 West Thirty-fourth street, New York city, is distributing a new catalogue descriptive of "Paragon" direct-current fan motors. This illustrates twelve and sixteen-inch standard desk fans, twelve and sixteen-inch trunnion desk fans, and swivel and trunnion bracket fans of the same size.

THE CRESCENT COMPANY, Chicago, Ill., specialty manufacturer and manufacturers' agent, now has the exclusive western agency for the Crescent time switch. This device automatically turns on and off show-window signs and hall lights at a predetermined time. Bulletin No. 305 issued by this company fully describes the apparatus.

THE L. B. ALLEN COMPANY, INCORPORATED, New York and Chicago, manufacturer of the Allen specialties, has produced a booklet entitled "If You Use Solder." This describes the use and gives the virtue of the Allen soldering stick, Allen soldering paste, Allen soldering salts, commutator lubricant and Allen "Al-Lectro" polish. This booklet will be sent upon request.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., has published a leaflet calling attention to the practicability and value of the motor drive in wood-working establishments. Half-tone illustrations of primitive and modern methods of working mill apparatus are supplemented by some pithy quotations and literature dealing with this subject.

THE ARNOLD ELECTRIC POWER STATION COMPANY, Marquette Building, Chicago, Ill., and Transit Building, New York city, N. Y., in bulletins No. 8 and No. 9 presents reprints describing, respectively, the Omaha shops of the Union Pacific Railroad, and the Baring Cross shops of the St. Louis, Iron Mountain & Southern Railway. The Arnold Electric Power Station Company does an engineering and contracting business, and makes a specialty of specifications and contracts for air, power, water, lighting and heating systems.

THE SPRAGUE ELECTRIC COMPANY, New York city, in bulletin No. 219 illustrates and describes its round-type motors for direct current. The half-tone illustrations are carefully worked up, and in addition to the illustrations of the parts of the motor, typical applications are shown. These include motors belted to die presses, direct-connected to exhaust fans, geared to pipe-cutter and threading machines, for use with a small portable electric drill, for use with an hydraulic wheel press, and for use with electric hoists.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING COMPANY, Yonkers, N. Y., manufacturer of "Habirshaw" wires and cables, is presenting some of its friends with a valuable souvenir in the shape of a perpetual pencil. This pencil is supplied with a number of refill points, and obviates the sharpening of points when the old one has been worn out. The pencil is manufactured by the American Lead Pencil Company. The sales department of the India Rubber and Gutta Percha Insulating Company is at 15 Cortlandt street, New York city.

THE CHANDLER & TAYLOR COMPANY, Indianapolis, Ind., will send upon request its new catalogue descriptive of the Chandler & Taylor enclosed automatic engines for belted or direct connection. The company states that this is the first line of engines built in this country to conform exactly to the recommendations of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers for direct-connected units. In addition to this point, there have been embodied some novel mechanical principles, which have been thoroughly tried for a period of two years, and which the company will guarantee. The engine is provided with large bearing surfaces, and is heavily built in every way. The bearings are made self-centering and self-oiling.

THE NERNST LAMP COMPANY, Pittsburg, Pa., has published a booklet entitled "The Value and Utility of the Nernst Lamp in the Central Station." The introductory statement is to the effect that, to secure a permanent position in modern central station equipment, an electric illuminant must possess, to a marked degree, originality and usefulness sufficient to create a field of its own, and advantages which will enable it to displace other modern illuminants, to the mutual advantage of the lighting company and its customers. The manufacturer states that the Nernst lamp possesses both these qualifications. The booklet takes up, under separate heads, the characteristics of quality, uniformity of light, efficiency, steadiness, absence of shadows, frequency, power-factor, high-voltage, non-sensitiveness to change in line voltage, simplicity in maintenance, pleasing appearance, and utility for various illuminating purposes.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, in bulletin No. 8 presents a number of types of electric locomotive for gathering purposes. This bulletin is by Mr. C. E. Waxbom. The distinctive feature of the electric gathering locomotive is that it may be operated over tracks where there is neither trolley wire nor steel rails. This is made possible by carrying upon the locomotive a reel of flexible insulated conductor. When it is desired to run on tracks where there is no trolley wire, the cable is connected to terminals provided for the purpose, and the locomotive is propelled by current taken from the cable. The cable is automatically paid out as the locomotive runs away from the terminals, and automatically rewound in even layers and with uniform tension upon the reel when the locomotive returns. The locomotive is also provided with a standard trolley, for use on portions of the haulage system where there is a trolley wire.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., through its publication department is distributing a notable series of bulletins descriptive of some of its products. These bulletins include price lists of type "HB" oil transformers, type "H" oil transformers, snap, pendant and punched clip switches, and Thomson recording wattmeters. A number of fliers describe supplies, including quick-break punched clip switches for 500-volt service, fuse wire, pendant switches, switchboard receptacles, flush wall receptacles and multiplex lightning arresters. The regular bulletins of the supply department describe and illustrate pocket instruments, cable-testing current transformers, sewing-machine motors and oil switches. Among the more pretentious catalogues is that describing General Electric fan motors. This is handsomely printed and illustrated, and gives in detail the mechanism and adaptation of the various types of fan motors. Another valuable contribution is a description of the Curtis steam turbine. In this publication is shown the steam turbine in various conditions of assembly, and the operating mechanism is illustrated and described in detail. Various forms of the built-up unit are also shown, and comparisons made with standard types of reciprocating engines of the present day. A notable effort is shown in the book describing lightning arresters. This comes bound in a handsome cover with a colored print of a lightning effect. In addition to a great deal of interesting reading concerning lightning arresters, there are illustrations of typical applications and forms and dimensions of different types of General Electric lightning-arrester apparatus.